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AND

AMERICAN RAILWAY JOURNAL.

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TABLE OF CONTENTS.

Engineering News of the Week 427, 441, 447

Technical Articles:

The New Ferry Boat Cincinnati, Pennsylvania Railroad (*with inset, illustrated*) 428
A Perfect Electric Motor 430
Legal Decisions of Interest to Engineers 431
Suggestions as to the Selection of Sources of Water Supply (*illustrated*) 432
Railways in India 434
The California Irrigation Hydrant (*illustrated*) 434
Cable Railways of Los Angeles, Cal 434
Underground Wires in Washington, D. C 441
The Godfrey Driven Well System at Fremont, Neb. (*illustrated*) 442
The Progress of Cable Motive Power for Street Railways 442
Cumberland Gap Tunnel (*illustrated*) 444
Saranda Tunnel, India 444
Clay Puddle 444
Track Standards on the Baltimore & Ohio (*illustrated*) 445
A New Topographical Survey 446
One Hundred Miles an Hour 446
Computing Approximate Areas by Diagram (*illustrated*) 447

Personals, New Publications, Society Proceedings 436, 437

Editorial Notes 438

A Correction—The M. C. B. Arbitration Committee Decisions on Car Interchange—Red and White Light Signals for Railways and Lighthouses—The Effect of the Nicaragua Canal on Californian Ports.

Editorials:

Newspaper Electrical Marvels 438
Past and Future Railway Speeds 439

Correspondence 441

Limit of Curves for Yard Work—The Richmond & Danville Bridge Accident—Remarkable Hoisting Record—Boston Rapid Transit Report: Correction—Notes and Queries.

Construction News 448-452

Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE BROOKLYN BRIDGE TRUSTEES have received $540,000 for the new terminal improvements, from the sale of bridge bonds by the cities of New York and Brooklyn.

THE CENTRAL WYOMING CANAL CO., capital $2,500,000, has filed articles of incorporation. The main canal is to be 150 miles long, 8 ft. deep and at the start 100 ft. wide on top, with a fall of a foot to the mile. They will tap the North Platte in Natrona county and reclaim approximately 250,000 acres. The ditch is to be completed by 1897 at a cost of $2,000,000. The company will have offices at Douglas, Cheyenne, Chicago, New York and London.

THE STREET-CAR LINES OF TORONTO have been secured by the municipality, and the city has leased them to private individuals for a term of years, receiving as rent $800 a year per mile of track, or $1,600 per mile of double track, and 8% of the gross earnings. Workingmen can secure eight-trip tickets for 25 cts., good for any time before 8 A. M., and between 5 and 6.30 for the return home. Children under 9 years are carried for half rates, and school-children's tickets are sold in bunches of 10 for 25 cts. Under this system the first month's returns placed $11,651 in the city treasury.

A NEW WOOD PAVEMENT is being tried in Paris, says *Industries*. It consists of pieces of oak about 4 in. long, split up similarly to the ordinary firewood, and laid loosely on end in fine sand on a bed of gravel from 4 in. to 4½ in. in thickness. A layer of fine sand is then spread over them, and they are alternately watered and beaten several times. In about 48 hours the humidity has completely penetrated and caused the wood to swell, and it is claimed that the mass becomes thus absolutely compact and homogeneous and capable of supporting the heaviest traffic.

THE TOWER OF THE PHILADELPHIA PUBLIC BUILDINGS is to be 512 ft. high. The marble portion, 337 ft. high, has been finished for some time, and the iron clock-story is now completed at the Tacony Iron Works. This portion is 70 ft. high and 70 ft. square, constructed on a skeleton of wrought iron, with a cast iron shell ¼ in. thick. This story will be surmounted by a dome of aluminum 105 ft. high and weighing 200 tons less than if cast iron had been used in its construction.

AN ELEVATED RAILWAY IN PHILADELPHIA is contracted for. This is to be built by the North-eastern Elevated Railway Co., and the Phoenix Bridge Co. has the contract. This road, which was approved by an ordinance passed in June last, starts at the county line, at Cheltenham Ave., and runs through the northeastern section of the city to Tacony and Holmesburg. It is to be double track, of lattice construction, proportioned to carry a live load of two locomotives, coupled, weighing 50,000 lbs. each followed by loaded passenger cars of 40,000 lbs each. The least clear height above streets is to be 14 ft. The estimated cost per mile is $500,000, and the total contract amounts to $2,500,000.

STEAM TRACTION ENGINES are, it is said, to be used by the owners of the iron mines near Haslett, San Bernardino Co., Cal., to haul ore from the mines to the railway, a distance of 20 miles. The engines were built by J. B. Osborne, of Daggett, Cal., to haul ore 100 miles across the Mojave desert, each engine hauling two wagons. Each train of wagons will make a trip every two days, hauling 20 tons of ore.

ALUMINUM is now selling in small lots at 90 cts. per lb. for the No. 1 grade metal; 75 cts. per lb. in ton lots. The No. 2 grade metal between 94% and 97% pure is selling at 65 cts. per lb. in ton lots. This is the grade of metal sold to iron and steel concerns. There is a growing demand for the metal among the steel manufacturers to solidify their ingot steel. The above quotations are furnished by the Pittsburg Reduction Co.

THE ONLY SERIOUS RAILWAY ACCIDENT reported this week was a head collision Oct. 29 on the Chicago, St. Paul, Minneapolis & Omaha R. R., near Menomonee, Wis. The passenger train ran past the place at which it should have met a freight train. Two engines, a mail car, 2 baggage cars and 5 stock cars were wrecked. Two men were injured.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: A bridge carrying the Richmond & Danville R. R. across the Dan River at Danville, Va., was knocked down as the result of a rear collision on the bridge Nov. 2. A freight train and a work train were running across the bridge to clear the track for the vestibule train. It was dark at the time, and the engine of the rear train ran into the train in front and knocked a coal car across the track. This car was jammed against one of the trusses, knocking some of the members out and causing the bridge to collapse, or pulling it off its seat, and carrying with it the engine and 4 cars, all of which fell into the river below, a distance of 40 ft. One man was killed and 3 were injured. On Oct. 26 a passenger train on the Birmingham & Atlantic R. R. broke through a burning trestle near Birmingham, Ala. Two men were injured. The cars were burned.

A TERRIBLE ACCIDENT occurred at the Anaconda mine, Butte City, Mont., Nov. 5. At midnight a new shift of 19 men had just started to go down when the rope broke, and the cage fell to the bottom of the shaft. There were 17 men killed outright, and the other two were fatally injured. The mine employs 400 men, and was reopened Oct. 23 after a long period of idleness.

THE NEW FRESH WATER LAKE in Colorado, formed by a crevasse through which the Colorado River is discharging into the vast dry basin below sea level, which is supposed to have been anciently a part of the Gulf of California, is now 30 × 10 miles in area, and 34 ins. deep, its possible area (size of the basin below sea level) being 180 × 30 miles, or about 18 times as great. Into this lake water is now pouring through the *main* break, 15 miles below Yuma (there being another 20 miles lower) at the rate of 1,800 cu. ft. per second, which is at the rate of about 1,166,400,000 galls. per day, the water being now comparatively low. Nevertheless, the evaporation is so rapid that the lake is lowering at the rate of one-quarter inch per day, which rate, however, is not fast enough to dry it up completely before the river rises again, while immense works would be required to close the crevasse. Many contend that the formation of a lake of full size should be favored in this arid region, but the general sentiment is as yet against it. Calling the area of the present lake 200 to 225 sq. miles, water is flowing into it at the rate of 90 to 100 ins. of depth per year, but evaporation is proceeding fast enough to absorb this, and 91 ins. per year more, or 180 to 190 ins. in all. A salt manufacturing company whose works have been greatly damaged has made the surveys from which these facts are taken, but it appears doubtful if they can obtain the relief desired or if it would really be well that they should.

THE SAN FRANCISCO-HONOLULU CABLE ROUTE has been partially surveyed by the U. S. S. *Albatross*. It is found to be impossible to bring the cable directly to San Francisco. To begin with, there is the bar with very rough water, and a rocky plateau extending 30 miles seaward with depths averaging less than 100 fathoms. From this ledge the water deepens within 10 miles to 1,061 fathoms, and in less than 20 miles to more than 1,700 fathoms. This angle of slope is impracticable for a cable. Of other points considered, Monterey bay seems to hold out the most promise. A depth of 54 fathoms with a muddy bottom was found less than half a mile from Salinas Landing. Soundings taken at mile intervals, for 7 miles, showed a gradual deepening of 50 fathoms per mile over mud and sand. Some shoals and abrupt depressions were found, and at 125 miles west of Monterey 2,112 fathoms were reached. This gradually deepened to 2,000 fathoms 330 miles off shore. For the next 250 miles the depths fluctuated between 2,600 and 2,900 fathoms, with soundings at 10 and 15 miles intervals. The route passed 40 miles to the northward of Belknap Mountain, a volcanic formation raising in 2,600 fathoms of water with its peak within 388 fathoms of the surface. A lava bed extends eastward from it for about 100 miles. The total route sounded extended to 850 miles off shore from Monterey and ended in 2,600 fathoms of water.

THE GEORGIA ROAD CONGRESS has adopted a resolution approving of the use of convict labor in road-making, and holding that labor and property should each bear their fair proportion of road duty, the latter to be an ad valorem tax. Each county is to decide as to the amount and character of the work to be done, and own and furnish the tools to be used. A complete revision of existing road laws is earnestly recommended. At the congress the Highway Improvement Association was formed, with all citizens of Georgia eligible to membership on the payment of 50 cts. per annum.

THE GALVESTON ARTESIAN WELL is now down 2,360 ft. and the 9-in. pipe is 12 ft. in a bed of water bearing sand. This pipe has now jammed, and the well is to be continued with a 6-in. pipe as soon as this can be procured. Above the sand stratum mentioned there is clay rich in fossils belonging to the Claiborne group of the Texas eocene.

THE POUGHKEEPSIE BRIDGE CO. defaulted payment of interest on its bonds last February, and holders of over $3,300,000 out of the $5,000,000 of bonds have accepted scrip in lieu of interest from the trustees. All of the floating debt of the railway company is provided for by general mortgage bonds. Some discontented bondholders talk of a receivership, but their plans and methods are distrusted by the majority of those interested.

THE STROWEGER AUTOMATIC TELEPHONE EXCHANGE CO., of Chicago, has been incoporated, with a capital of $5,000,000. The device is the invention of A. STROWEGER, of Eldorado, Kan. On the telephone shelf is a row of keys indicating units, tens, hundreds and thousands, and a release key. The subscriber taps out the desired number to the central office; this number is registered on a machine, and, if all is clear, automatically connects the number called for with the wire of the subscriber.

THE LAKE HEMET DAM, says the San Diego *Sun*, will be 150 ft. high and 200 ft. thick at the base. It will be built of granite laid in Portland cement; is situated in the northern part of San Diego County, and will flood an area twice as great as that of the Sweetwater reservoir.

The New Ferry-Boat "Cincinnati," of the Pennsylvania Railroad.

(WITH INSET.)

For many years the type of vessel in almost universal use in the eastern United States for ferrying passengers and vehicles across bodies of water of moderate width remained substantially unchanged. The chief features of the standard ferry-boat are too familiar to need mention here. Paddle-wheels driven by walking-beam engines have long been in practically universal use for their propulsion and have been considered a necessity for properly manœuvring the boat in entering shallow slips. At the Boston meeting of the American Society of Mechanical Engineers in 1885 Mr. WM. COWLES presented a paper on "Improvement in Ferry-Boats," in which he advocated the use of screws instead of paddle wheels for ferry-boat propulsion, and presented an outline drawing of a boat propelled by screws at each end on independent shafts, connected at the middle of the boat by a universal joint.

At that time the officers of the Hoboken Land & Improvement Company were at work on designs for a ferry-boat to be propelled by screws; and the result of their labors, the now well known *Bergen*, was put in service in 1889. An exhaustive paper giving a history of the use of screw propulsion on ferry-boats and comparing the performance of the *Bergen* with the most modern examples of paddle-wheel boats was read before the American Society of Mechanical Engineers at the New York meeting in November, 1889. Since that time the *Bergen* has been in regular service; and she has so well proved her superiority to the paddle-wheel boats that it is safe to say that the screw system of propulsion is destined to replace the old paddle-wheel system for ferry service, except where special circumstances may render the use of the former inadvisable.

The next screw boat to be built for the North River ferries was the *John G. McCullough*, put in service on the New York, Lake Erie & Western R. R. ferries in the spring of 1891. This vessel was built by the Neafie & Levy Shipbuilding Co., of Philadelphia. It has shown the same superiority in ease of handling, surplus of power and high speed as the *Bergen*.

The Pennsylvania Railroad has now followed the example set by the Hoboken and Erie lines, and its two new double deck ferry-boats, *Cincinnati* and *Washington*, the first of which has her trial trip to-day, Nov. 7, are propelled by screws. In many respects, however, the design of the earlier boats has been departed from, and this is especially the case with the engines; which, instead of being triple-expansion, as is the case with the *Bergen* are of the "steeple-compound" type, the low pressure cylinder being mounted on top of the high pressure cylinder, and having a common piston rod.

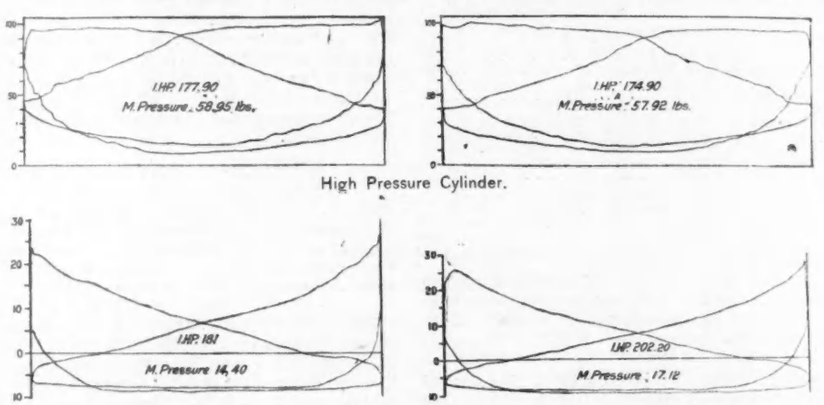
It is generally accepted by engineers that in the design of an engine for intermittent service, such as that performed by ferry-boat engines, there is a point where a triple-expansion engine becomes less economical than a compound, on account of the amount of heat absorbed in warming up the low pressure cylinder at the beginning of the trip. At what length of trip the additional expense of a triple expansion engine is warranted by its economy is a point on which there is room for much discussion and difference of opinion. We are informed that experience on the *Bergen*, notwithstanding her comparatively long run of 1⅝ miles, has been such that two new boats for the Hoboken ferry, now nearly completed, are to have compound instead of triple expansion engines.

The *Cincinnati* has a shorter route than either the *Bergen* or the *McCullough*; and we understand it to be the opinion of her designers that a triple-expansion engine would be on the whole less economical than the design adopted. There were, however, other reasons for adopting the steeple compound ergine on this boat. Some years ago the Pennsylvania officials concluded that the advantages of interchangeability might as well be obtained for their engines in marine service as for their locomotives. They therefore settled upon a standard tug boat engine, which is now in use throughout their fleet of tug boats, over 30 in number, which work in the harbors of New York and Philadelphia. This standard engine has given such satisfaction that it was concluded to adopt it for the screw propelled ferry-boats, two of the engines being set side by side, thereby facilitating repairs and decreasing the cost of maintenance. The criticism is sometimes made upon the steeple-compound that it is difficult to keep the packing tight between the high and the low pressure cylinders. On the Pennsylvania engines a metallic packing is used here, and little trouble has been experienced.

The accompanying engraving is reproduced from a photograph of the engine set up in the shops. The high pressure cylinders are 18 ins. diameter and the low pressure 36 ins. diameter, with a 26-in. stroke. The engines have independent air and circulating pumps and cylindrical surface condensers, and are fitted with Canfield's balanced piston valves. There are two boilers of the return tubular type, carrying a steam pressure in regular service of 120 lbs.

Each boiler is 10 ft. in diameter and 10 ft. long, and has 49 sq. ft. of grate surface and 1,750 sq. ft. of heating surface. There is also a donkey boiler 42 ins. diameter and 6 ft. 9 ins. high; and in connection with it is a circulating apparatus by which a uniform temperature is maintained throughout the main boilers while steam is being raised. A grease extractor is connected with the exhaust pipes of the various engines to prevent the oil used for cylinder lubrication from passing with the feed water into the boilers.

Three test trips of the boat have been made, during which indicator cards were taken at 15 minute intervals. Accompanying is a sample set of cards



INDICATOR CARDS FROM ENGINES OF FERRY-BOAT "CINCINNATI."

(Steam, 105 lbs.; Vacuum, 24.3 ins.; Rev's., 94; I HP., 736.)

taken during one of the trips with the engines working at moderate speed. With steam at full boiler pressure (120 lbs.) and the engines making 106 revolutions per minute, the engines have indicated 1,026 HP., giving the boat a speed of 14 miles per hour. In the long distance tests of the *Bergen* and *Orange*, described by Prof. J. E. DENTON in Trans. Am. Soc. M. E., Vol. XI., pp. 380-450, the average indicated HP. on a 120-mile run was determined to be 665 and 490 respectively. The average speed for the whole run was 11.88 and 11.5 miles respectively. The *Bergen*, by accumulating steam pressure in her boilers, has made a run over a mile course opposite Spuyten Duyvil at a speed of 14.6 miles per hour, the engines making 163 revolutions and developing 1,007 HP.

The main shaft of the *Cincinnati* is 9 ins. in diameter, and has at each end a four-bladed propeller, 8 ft. 9 ins. in diameter and 13 ft. 6 ins. pitch. The shaft is coupled between the two engines, so that in case of accident to either engine or either line of shafting they can be disconnected and used independently. On each side of the engines is a thrust-bearing, consisting of collars on the shaft, between which are horseshoe-shaped bearings attached to a casting which is firmly fastened to the frames of the hull. It is through this bearing that the thrust of the propeller is transmitted to the vessel. The lower casting of the thrust-bearing forms an oil reservoir and the lower half of the shaft is immersed in oil, thus insuring thorough lubrication.

This boat is equipped with two Williamson steam steering engines of a type that was originally designed by the manufacturers for the Pennsylvania Railroad Co., and was first placed in service on their ferry-boat *Chicago*, June 17, 1886. These engines are placed in the hold almost directly under the pilot houses, which gives direct connections from the steering wheels to the engines, and uniform leads for the tiller ropes.

There is attached to the bell gear a specially designed indicator connected with the engine room, which shows the engineer from which pilot house the signals are being given. This is arranged so that the handles connected with this indicator have to be raised before the pilot can ring the "go-ahead" bell, thereby preventing any mistake or neglect in his part to operate the indicator. There is also in front of the pilot a dial indicator showing the direction in which the engines are working, so that he will always be advised whether his signals are being answered promptly.

The principal dimensions of the boat are: Length over all, 206 ft.; length of hull, 200 ft.; beam over guards, 65 ft.; beam of hull, 46 ft.; depth of hull, 17 ft.; draft, 10 ft. 10 ins.; displacement, 880 tons.

We have alluded to the use of the compound engine as an important feature of the boat; while this is true from an engineering point of view, the most important feature of the boat for the comfort and pleasure of passengers is the cabin on the upper deck, which will be chiefly used by passengers going to or from the trains on the Jersey City side. In describing the new Jersey City terminals of the Pennsylvania Railroad in our issue of Oct. 3, we described the advantages of this double-deck system of handling traffic. Those who have been in the upper cabin of the double-deck side-wheeler *New Brunswick*, now running on the Cortlandt St. ferry, can testify as to the contrast in light and cleanliness which it presents to the ordinary ferry cabin. The upper cabin of the *Cincinnati* is 87 ft. long and 38 ft. wide. The lower cabins are each 144 ft. long and 15 ft. wide. The total area of floor space in the three cabins is about 3,800 sq. ft.

CONSTRUCTION OF THE HULL.

From the plan and sections of the vessel, shown on our inset sheet, with the side elevation, a very good idea of the general form of the hull lines may be obtained. It will be seen that the cross-section is of the V form which has found such favonon screw propelled ferry-boats, while the old style side-wheel boats have the sides of the hull steeper, with a flatter floor A most important point in the design of ferry-boat hulls is the shape of the load water line. When a boat reaches her slip at the end of a trip, passengers and trucks crowd on the front of the boat during the rush hours and bring a concentrated weight there. If the load water line is wide at the center and narrow at the ends, (diamond shape), the front end will have to be depressed a considerable distance before the increased displacement there and the decreased displacement at the rear will balance the load. But if the form of the load water line approximates a rectangle, the greatest loads ever

brought on one end will have slight effect in depressing it.

The plan of the interior of the hull and the sections amidships and near the bow, on our inset sheet, show that this boat carries her mid-section width well toward the ends.

But of more importance than the form of the hull is its construction. The boats must make regular trips in all weathers at all seasons, must plow through floating ice in winter and must be able to stand severe thumps from any quarter. In time of heavy fog, or when the river is crowded with vessels collisions with other vessels sometimes occur; and in making the slips when the tide is running fast or when intervening boats prevent a straight entry the boat often strikes heavily against the side of the slip.

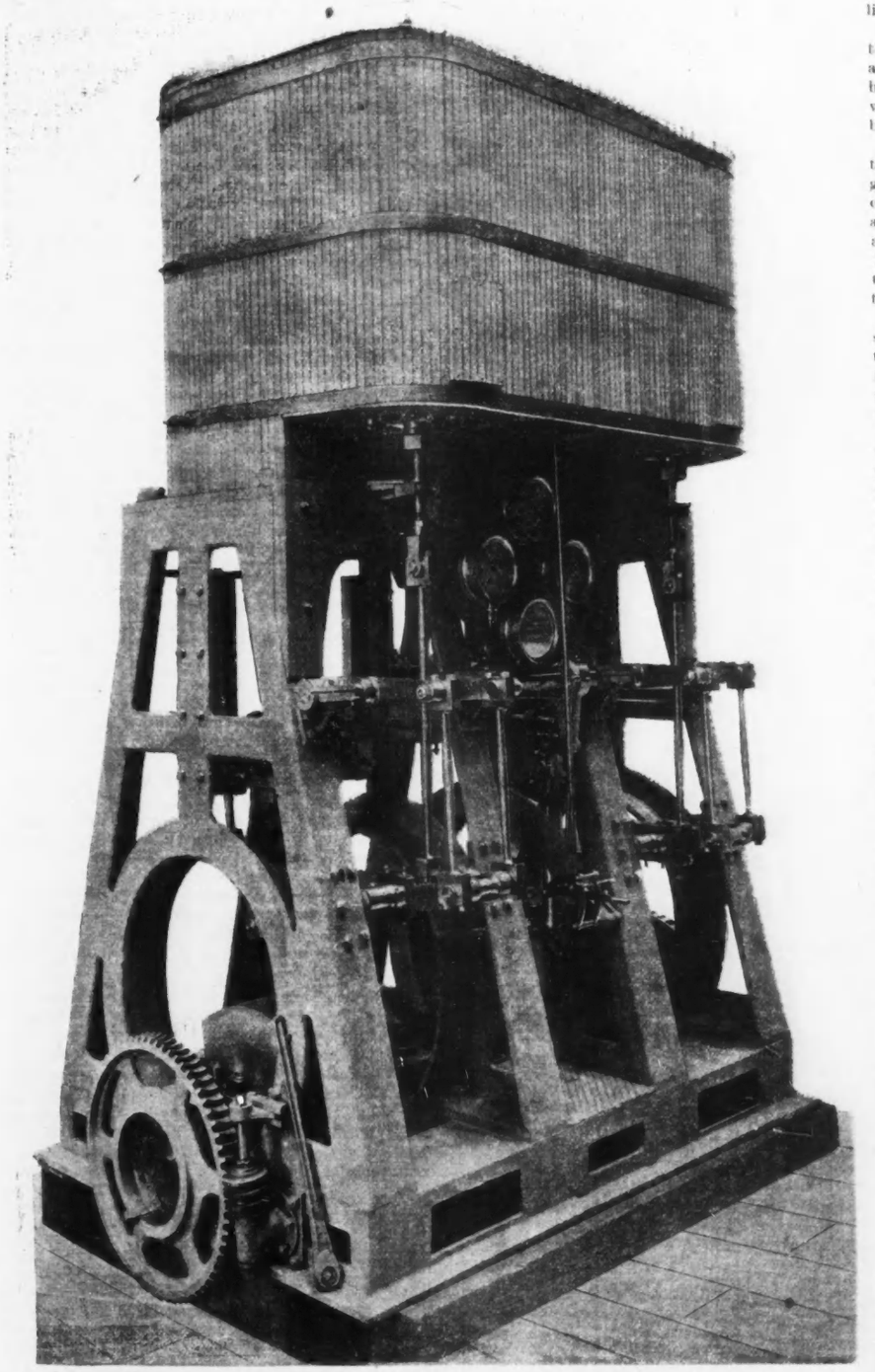
As seen by the plan view, the hull is divided by bulkheads into 14 water-tight compartments. There are 2 fore-and-aft bulkheads, located 14 ft. each side of the center and 18½ ft. from the outside of the guards at the midship section. The midship transverse bulkhead separates the engine-room from the fireroom; those on either side shut off the fireroom and the engine-room from the intermediate compartments; and the end bulkheads correspond to the "collision bulkheads" of the ordinary vessel. The midship cross-section best shows how thoroughly well protected is the boat against injury by collision. A tug or other vessel striking the side of the boat must break its way through the heavy guard timber and the deck beams and flooring for a distance of 9½ ft. before reaching the hull itself. It must then break into the vessel 9 ft. further before it can penetrate any interior compartment of the vessel. The outer compartments, owing to the V shaped section of the hull, will ship no large amount of water even if penetrated below the water line.

But the large amount of force necessary to break through the heavy guards and the iron deck beams and the work expended in crushing or injuring the bow of a colliding vessel would be apt to stop a vessel of considerable size, moving at a good speed, before the central compartment was penetrated.

As for collisions in which the ferry boat strikes the other vessel bows on, the arched form of the guards at the bow and the length of overhang there enable the boat to strike a heavy blow without damage to herself. This was well illustrated three years ago when a ferry-boat of the Central Railroad of New Jersey on the North River, ran into and sank the iron steamship *Atlas* with practically no damage to herself.

The material of the hull, as shown by the midship section, is iron throughout; even the stairs and the floors are of iron plates, and all the machinery foundations, as shown on the plan are built of plates and angles secured to the iron frames of the hull.

The use of iron deck beams and iron plates over the whole top of the hull is an important feature in the vessel's construction. With the wooden beams usually used for ferry-boats, the deck adds comparatively little to the strength and stiffness of the hull. With the iron deck, however, securely fastened to the frames, the hull becomes a stiff longitudinal girder and much better able to resist vibrations of the engine, and strains on the seams of the hull due to collisions, etc.



SIEEPLE-COMPOUND ENGINES OF SCREW FERRY-BOAT "CINCINNATI," FOR NORTH RIVER (NEW YORK TO JERSEY CITY) FERRIES OF PENNSYLVANIA R. R.

HEATING AND VENTILATING APPARATUS.

The ordinary method of heating ferry-boats is by steam pipes placed under the seats; and ventilation is provided by half a dozen, more or less, grated openings in the ceiling, leading to the outer air and covered with a cowl. This answers very well while traffic is light, on short-trip ferries where the opening of the doors at the end of each trip helps to change the air in the cabins. But during the rush hours of ferry service when the cabins are crowded with passengers, the air becomes rank with foul odors, especially on a rainy day when the exhalations from dripping umbrellas and outer garments help to make an unbreathable atmosphere. This evil of foul air in ferry-boat cabins is doubtless the most serious one in connection with ferry service as ordinarily carried on. That it is an evil whose remedy is easy, every engineer knows. There are many difficulties in applying a system of fan ventilation to a large theatre or other audience chamber; but these difficulties largely disappear when the space to be ventilated is a ferry-boat cabin. The noise or vibration from engine or fan is not noticeable; the cost of the extra attendance is nominal; and it is easy to bring in the fresh air and carry out the foul without producing objectionable drafts.

Three of the drawings on our inset sheet illustrate the ventilating and heating system as applied to the boat by Messrs. B. F. Sturtevant & Co., of Boston.

The fresh air is taken from a point above the upper deck through a vertical pipe, 38 ins. in diameter, and passes to a Sturtevant blower, located in the first compartment of the hold to the right of the engine room. This forces it through a nest of steam pipes which warm it to a temperature depending on the speed of the blower and the pressure of the steam in the pipes. These heating coils use exhaust steam from the auxiliary engines.

From the heating coils the warm, pure air passes into pipes leading to the different cabins. One 14-in. and one 15-in. main supply the men's cabin, where tobacco smoke is omnipresent, while a 13-in. and a 14-in. supply the women's cabin. An 18-in. and a 16 in. main lead to the cabin on the upper deck. To properly distribute the warm and fresh air and avoid drafts, it is delivered through openings in the inner wall of the cabins near the ceiling. Flues are made between the studs of the side walls, having a cross-section 3½ × 24 ins., and a branch from a main distributing pipe enters these, as shown in the trans

verse section. The temperature is governed by electro-thermostats controlling valves which regulate the hot and cold air supply at the heater.

But a perfect system of ventilation must provide means of exit for the cold and impure air as well as supply warm and fresh air. As the latter is forced in by the blower, all that is necessary is to make openings at the proper points for the foul air to go out. On the *Cincinnati* the foul air exits are placed under the seats close to the floor and the cold air and the air charged with carbon dioxide gas passes out of these openings into the vehicle gangway.

We have described and illustrated this system with considerable fullness, because we believe it to be by far the most important reform needed in connection with ferry service as ordinarily carried on. That the system with some modifications in detail, could be applied to existing ferry-boats, there is no doubt, as it is being incorporated in some of the older boats of the Pennsylvania Railroad and will eventually be placed in them all. And that it, or some equivalent system, should be applied to them, or at the very least to all new ferry-boats hereafter built, is a proposition which no one with a proper appreciation of the evils of foul air will contradict.

PROTECTION AGAINST FIRE.

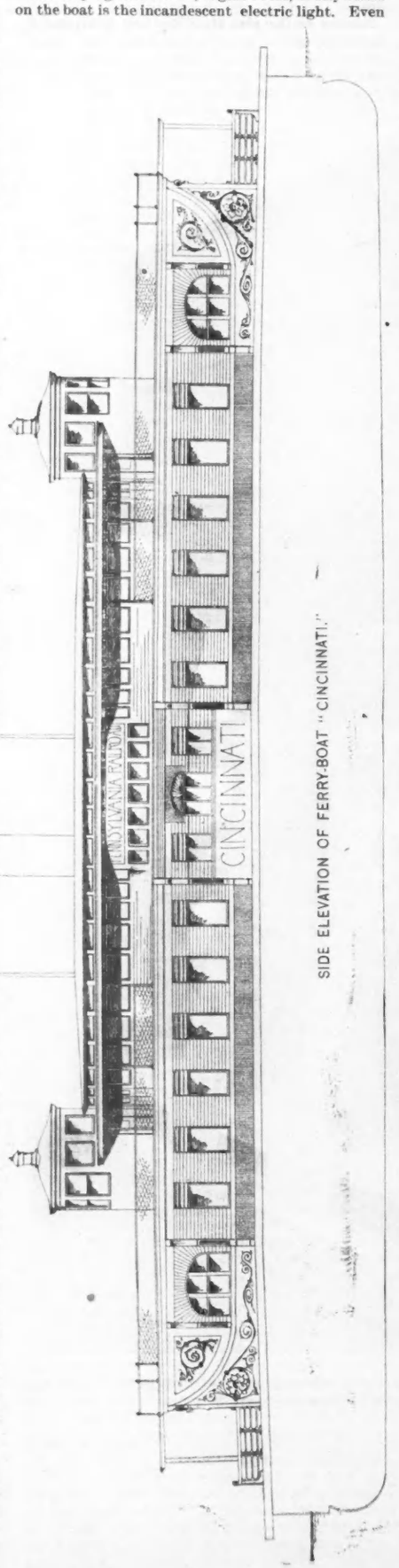
Second in importance only to the question of proper ventilation is the matter of protecting the passengers against fire. It may be thought that in such a crowded thoroughfare as the North River it would be impossible for a boat to burn so quickly that there would not be ample time to rescue her passengers. That this is not the case, was proved by the burning of the Pennsylvania Railroad's ferry-boat *New Brunswick* in 1889. The boat had just loosed from the Jersey City slip when a sudden fire in the hold drove the engineer from his post, and almost immediately broke through to the cabins on the upper deck. The boat was so near the bridge that ropes were thrown out and the men at the windlasses pulled the boat back to the bridge. There were but few passengers on board, and yet in the panic of getting off the boat some of these were severely injured. Several truckloads of goods with the horses attached had to be abandoned to the flames, so rapid was their spread. Five of the company's tugs were at work close by and at once began pouring heavy streams of water over the burning vessel; yet she had to be pulled out of the slip to keep the ferry house from taking fire, and she finally burned to the water's edge and sank.

So graphic an object lesson of the dangers to which passengers on wooden ferry-boats are subjected was not lost upon the officers of the Pennsylvania Railroad. In the new boats every precaution against fire seems to have been taken, if we except the radical one of building the cabins of incombustible materials; and although the cabins are built of wood, the priming coat used in painting was fire proof asbestos paint.

As already stated, the hull of the vessel is of iron, and there is absolutely nothing combustible in the hold; floors, stairs and all are of iron. As seen by the midship section, the house which covers the engines and machinery is also of iron. It extends to a point 9 ins. above the hurricane deck. The deck planking is of 4 × 4 in. white pine; but even this is sheathed on the lower side with iron plates $\frac{5}{16}$ in. thick, so that it cannot take fire from the hold; or if it were set on fire from above it could not send flame into the hold. It is evident, therefore, first, that if the upper works of the boat are ever burned, it will not be by fire set from the hold; second, that even should the upper works take fire, the engineer will not be driven from his post, but can manœuvre the boat according to the pilot's instructions, long enough at least to bring the boat into a position safe from adjacent vessels, and probably long enough to allow the boat to reach her slip.

From the description of the system of heating just given, it is evident that no fire is to be apprehended from it. The maximum heat of the air passing through the flues to the cabins will always be much less than that of the steam in the heating coils.

The only light in cabins, engine-room, or anywhere on the boat is the incandescent electric light. Even



the signal lights outside are electric lights. A few oil lamps are carried on the boat, but their lighting or use is strictly forbidden except as a last resort. The electric lighting plant on the boat includes one 200-light and one 35-light Edison dynamo. The latter is held in reserve for use in case the necessity arises of stopping the large machine. The lights on its circuit include the signal lights, sufficient lights for the engine-room and a few lights in each cabin. Only in case of the simultaneous failure of both these plants, are the oil lamps to be lit.

It may be said that fire might possibly be set on board the boat by the electric wires; but the necessary precautions for safe wiring are now well known, and we feel safe in saying that all precautions necessary to make the wiring absolutely safe were observed in this case. The only possible causes of fire originating on board, therefore, seem to be a boiler explosion, an explosion of oil in the engine room, or fire from combustible materials brought on board in trucks crossing the ferry. Of the two former it is to be said that ample precaution seems to have been taken to prevent fire communicating from the hold to the upper works, in case of its originating there. A boiler explosion would have to be pretty severe to destroy the heavy deck beams; and the scattered coals, being underneath the boiler, would in all probability remain in the hold and would not reach the combustible upper works.

DECORATION AND FINISH.

Like the *Bergen* and the *McCullough*, referred to above, the *Cincinnati* has her passenger cabins decorated in a style far in advance of the usual ferry-boat finish. Indeed, she is believed to be superior in this respect to any ferry-boat yet built. The upper deck cabin is handsomely carpeted, and has walls and ceilings finished in pink tints, relieved with aluminum leaf. The electric lights are on silvered brackets, with opalescent shades. Two large clusters of lights are placed opposite the stair-landings. The seats are of mahogany, with bent wood seat arms secured by silvered fittings. The upper cabin has seats for 166 persons. The stairs to the lower cabins are of mahogany, encased in leaded glass partitions. Around the upper deck cabin there is a broad promenade, and seats are placed outside for the use of passengers in pleasant weather.

The lower cabins are decorated in light pearl gray tints, with papier mache festoons on the frieze. The roughened canvas panels are relieved with aluminum leaf. The floors are of mosaic tiling, commendable for both its appearance and sanitary cleanliness.

The number of seats in the lower cabins is 304. The design of the seats and electric lights is similar to that in the upper cabin. The total number of electric lamps (16-candle power) in the three cabins is 112.

Credit for the design of the boat and machinery is due to the Motive Power Department of the United Railroads of New Jersey division of the Pennsylvania Railroad. Mr. H. S. HAYWARD is superintendent of motive power and Mr. F. L. DU BOSQUE is his principal assistant in charge of boat construction. The hull of the *Cincinnati* was built by the Crescent Shipyard & Iron Works, of Elizabethport, N. J. The engines were built at the Pennsylvania Railroad shops at Hoboken, N. J. The joiner work was done by J. E. Hoffmire & Son, of New York City, from plans made by Messrs. Furness, Evans & Co., of Philadelphia.

The sister boat to the *Cincinnati*, which is exactly like her in every detail, the *Washington*, will be ready for service some time next spring.

A Perfect Electric Motor.

The following are the conclusions in regard to a perfect electric motor for street railways, presented in a paper by Mr. H. A. EVERETT at the recent convention of the American Street Railway Association.

Taking the trolley wheel, pole and stand, I think it desirable to have a wheel that is capable of following the wire at any angle, with a trolley pole brittle enough to break should it become entangled in the wires, without pulling them down, and a trolley spring rigid enough to give good, steady pressure on trolley wire, and so constructed that when the car is in the car house or going under a low bridge, the pole could come very close to the roof of the

car, also flexible enough to give good pressure when the trolley has to be 21 or 22 ft. high at the railway crossings.

The car should have a lamp circuit, with plenty of lamps distributed properly. The motor ought to have a reliable fuse plug, that will invariably blow before injury is done to the machine. Have on each car the best lightning arrester that can be secured in the market.

In coming to the motor proper, it is desirable to use a controlling switch that is easily operated and readily reversed, in case of accidents. The simpler the controlling device the better, and it should be constructed with a view to guard against any possible disarrangement of the parts, so that it will be reliable in all cases, both electrically and mechanically. The rheostat should also be carefully looked after, and properly protected to keep it from injury, by reason of water, snow or dirt getting upon it. It should only be available in starting the car to avoid the lunge of a start, and should be so arranged as to be cut out as soon as the car is started, and give the entire efficiency of the motor proper. The motor should be well protected in all its parts from any outside interference, so that in running along the street it will be impossible to pick up nails, wire, or anything that would short circuit it, at the same time observing that a motor must be properly ventilated to keep it from heating while in use. The cover should be made so as to be easily removed. It is advisable to have an armature of large diameter, making a small number of revolutions per minute, with the bearings made of extreme width, with proper grease-cups, and in such a condition that they can be readily re-babited when slightly worn. The diameter of the commutator should also be large, and to have the brushes easy of access is very desirable. The winding of the armature ought to be of the simplest kind, and the size of the wire and insulation of same should be carefully looked after. I think the insulation of wires in armatures is at present one of the weakest points in the motor.

The armature gears should have a wide face, and run in oil. The armature shaft ought to be of ample diameter, and there is nothing gained by having the key way too small for the securing of the commutator to the shaft. The commutator should be carefully insulated, so that there will be no grounds between it and the case. The box in which this gear runs ought to be constructed of copper, or some light material that is somewhat flexible, so that if struck from the outside it will bend rather than break. The fields should also be wound with a wire of better insulation, and of ample size to take the current. Of course, in this particular, I do not intend that the wire of either the field or armature should be great enough to take more horse-power than ought to be used by the machine. To my mind it is very desirable to have the armature in such a condition that it can be readily taken out from the machine and put in again.

One of the serious disadvantages to operators of electric roads is the expensive labor necessary in winding the armatures and fields, also in regard to high-priced mechanics who ought to be employed to attend to the machines. There is nothing gained in employing a cheap class of labor to handle an electric equipment, either as electricians, armature or field men or mechanics. At present, I think the single reduction motor is the nearest perfection of any on the market. The electric companies should devote some time to the perfection of an electric brake to stop the car with the same power that runs it. Electric heaters are now used in quite a number of places, and I think will prove quite satisfactory. Electric signal bells seem to work very well. For a dasher gong on a motor car I am in favor of a foot tread, as in testing an electric gong we found that our men used it altogether too freely.

I am in favor of an oil headlight, one that can be removed easily, so that in the event of a trolley being broken or anything happening to the electric part of the car, or a light is desired underneath the car, the oil headlight can be used to better advantage than the electric. There ought also to be one oil light in every car for the same purpose. There is no reason why an electric fare register cannot be made to work successfully.

The durability of the motor is a question which requires very careful attention. The single reduction motor, when properly looked after, ought to last for many years. We have had one in operation for over 10 months, and it appears to be in as good condition as when it first went on the road. The car should be of moderate size, constructed with all modern conveniences, but without fancy decorations or any unnecessary display.

The cars should be run on frequent headway, and at all hours of the day and night, at as high a rate of speed as the civic authorities will permit. The noise of the motors has been very largely done away with, and by careful attention the old counter shaft machines can be used until worn out by simply covering the gearing with an oil box, and by not attempting to run them too many miles without inspection.

DISCUSSION.

Mr. STEPHENSON, of Washington.—In the city of Washington we are prohibited by an Act of Congress from using any other power than some conveyed power underground, or horses. By a recent Act of Congress the two principal lines were required to change their motive power within two years. One of these lines has entered into the construction of a cable road, a part of which is completed and in successful operation.

The other line is, I believe, operated, or intends to operate, by the storage battery system. I believe matters are in an experimental stage. This appears to be the only method of operation that we can have in the District of Columbia, in the way of an electric road, as the system of overhead wires for the present is out of the question. I believe there is nothing in the way of a successful under, ground or storage battery system in operation. I would like to get some opinion in regard to the comparative cost in operating electric and horse roads. We are anxious to change our motive power, and, like everybody else, we want the best.

Mr. HENRY, of Pittsburg.—My last annual report shows that our total cost including conductors and motormen, all repairs, maintenance of way, general expenses and all other charges amounted to 20.26 cts. per mile. Separating this into strictly operating expenses and fixed charges we have operating expense of 12.74 cts. per mile, and in comparing the same with the cost of operating the horse line, which was 10 cts. per car mile, we must remember that we then paid but one man on a car. This increased cost per mile for conductors and motormen is a necessary adjunct of rapid transit, and is not peculiar to the system. Allowing this, we have a distance of 1.01 cts. per car mile in favor of electricity against animal power.

Mr. BICKFORD, of Salem.—We have equipped our lines and run 12 cars. Formerly it took 18 cars to do the work that 12 now do. On one line where we ran 12 cars by horses we run 8 electric cars and carry more passengers.

Mr. STEPHENSON.—We have about 20 cars on our road, and I am satisfied that when we put on the electricity 12 or 14 cars will carry the same number of people as the 20 now do. I am also satisfied that we shall have an increase in our travel of 25 or 50%. The point we want to know is the relative cost between electric cars and the horse cars; how much we are going to make by the change or how much we are going to lose.

Mr. PEARSON, of Boston.—Our road has about 350 cars equipped with electric motors. The expense of operation with horses is about 25 cts. per car mile including everything connected with the operation, fixed charges and track repairs. In Boston the cost of operation is high as compared with some cities. You will find in many cities the cost of operation of horse cars is below 25 cts., but we pay a good price for labor, on account of the running of our lines in the congested parts of the city, where we cannot get as much work out of a man as you can in other cities. This makes a greater cost of operation. The cost of operation with electric motors up to the present has been about 20 cts. per car mile. The increased cost of operation in our cities is also true to a great extent with electricity. We pay 25 cts. a day more for motormen and electric car conductors than we do for horse car conductors and drivers. That has been our experience up to this time; we save about 25%. Our men are expected really to work 10 hours a day, but we actually get anywhere from 7½ to 9 hours a day. The amount of power consumed is considerably more on account of the slow speed with which the motor powers have to operate in the downtown portions of the city. There the streets are crowded with teams and cars, and I suppose that the cars run at an average of perhaps 1 or 2 miles an hour for a distance of from ½ to 1 mile, which, of course, decreased the profits very materially. We expect to get the cost of operation down to 16 or 17 cts. per car mile. Another item of expense to us is the high cost of power, we having been obliged to hire power from an electric company and pay a good price for it, much more than it would cost a street railway company if it had its own power house. We began with a 16-ft. motor car very similar to the old horse cars. We have changed from that to a long car, which is 26 or 28 ft. long in the body and 35 ft. over all; that is the car we have adopted as our standard. For our purpose we find a decided improvement in earnings and saving in operating expenses per passenger with the long car. I imagine that the conditions in Boston determine that for us, and in other cities it may be that the short car would be more profitable for operation. We find the long car earns a great deal more per car mile and we only need the same number of men to operate it as with the short one. From our tests we find that the amount of power consumed on a level track is very little more for the long car than with the short one, in fact the weight which we have in the car seems to have little to do with the current consumed as long as the car is on a level track.

From tests we found that a long car, empty, weighing perhaps 18,000 lbs., using a certain average amount of current that the same car loaded with 15,000 lbs. of weight, used very little additional power until we came to a grade. We have experimented in this matter, and could hardly tell from the reading which was the empty and which the loaded car. That being the case, it does not cost much more to operate long cars than short cars. Again, they carry nearly double the people, and do it with the same expense for conductors and drivers. Just how much more heavy cars will increase the track repairs we cannot tell at present. The last line that we have started has 26 long cars. We run on the same headway. Our additional passengers are persons who prefer to take our cars rather than the steam road. A great many people who formerly traveled on the steam road for short trips prefer to take our electric cars. The ride is pleasant, and in the suburbs we go very quickly.

Mr. BALLARD, of San Antonio.—The gentleman from Washington tells us of certain statistics he had seen, and that while certain cable and horse roads had paid dividends, 36 electric roads had not paid any dividends. I happen to know, from having seen the figures of a good many roads, that the profits they made were absorbed in paying bills for the new equipment. The shareholders, instead of making more advances of money, allow the profits to be used for that purpose. As to the advantage of these electric roads over a horse road, I do not think sufficient allowance is made for the natural increase of travel, and that people prefer to ride on an electric car. In San Antonio the entire line has been equipped within the last year. The total gross revenue of the old horse line runn ing regularly was about $6,500 a month. We are now running at an average gross income of $12,000 a month, with only an increase in the population of about 2,000. Our receipts are increased nearly 100%, while the mileage is very little increased. Our total outlay for operating expenses in earning $12,000 against $6,500 per month is only an increase of 12%. We pay $5.50 per ton for coal.

Legal Decisions of Interest to Engineers.

Construction Damage.—In an action by the owner of abutting property against a railway company for damages to the freehold and for diminishing the annual value of the premises for the use, there can be no recovery as to the freehold where the market value has been increased, but as to the latter there may be a recovery, notwithstanding such increase in the market value. A wrongdoer cannot set off increase of market value, caused by his wrongful act, against loss of rents and profits occasioned thereby. (Davis v. East Tenn., V. & G. Ry. Co., Sup. Ct. of Ga., 13 S. E. Rep., 567.)

Uniform Specifications for Competitive Bidding.—Where the law requires all contracts for public work to be let to the lowest responsible bidder, the same specifications must be submitted to all bidders, as there can be no real competition unless the competing bids are based upon the same data, and a law which requires that plans and specifications and bids for the work shall all be advertised for at the same time, is therefore unconstitutional. Fones Bros. Hardware Co. v. Erb, Sup. Ct. of Ark., 15 S. W. Rep., 7.

Liability to Boys Injured While Playing on Turntable.—If a railway company constructs a turntable in a place easily accessible to the public and takes no means to prevent them from going to and upon it, it is liable in damages to a boy who is injured while playing upon it, when it was left unguarded and unfastened. The company should not leave a dangerous piece of machinery like this in such circumstances.—Ft. Worth & D. C. Ry. Co. v. Robertson, Supr. Ct. of Tex., 16 S. W. Rep., 1,093.

Damage by Overflow of Railroad Embankment.—Where a railway company constructs an embankment without the culverts required by law, it is liable to adjoining landowners for damages caused by overflow of water, and each overflow is a separate and distinct cause of action. It is not negligent for the owners of such land to plant crops where he knows they will be damaged if the land is overflowed. He has a right to use the land as he may see fit.—Clark v. Dyer, Supr. Ct., of Tex., 16 S. W. 1,000.

Liability for Sudden Washout.—A railway company which has performed the duty of inspecting and keeping in safe condition its tracks and roadbed with that degree of diligence which the law requires of it, is not liable in damages to one of its engineers for injuries occasioned by running his engine into a washout or chasm by a sudden, most violent, and unprecedented rainfall, such as the oldest inhabitants of the neighborhood had never before witnessed; the calamity being directly attributable to the act of God, for which no individual or corporation is ever held responsible.—C. R. & B. Co. v. Kent, Supr. Ct. of Ga., 13 S. W. Rep., 502.)

Failure to Examine Coupling.—When a rule of a railway company requires all employees to examine the coupling apparatus of roads before attempting to make the coupling, and provides for ample time for them to do so, an employee who is injured by stepping between a car and an engine with unusually short drawbars, which he could have seen by obeying the rule, cannot recover damages from the company for his injuries.—Bennett v. N. P. Ry. Co., Supr. Ct. of No. Dak., 49 N. W. Rep. 408.

The Omaha Bridge Case.—A contract giving one railway trackage rights over part of the line of another company was signed and attested by the proper officers of the latter company. It was approved by the executive committee, which, under authority of the board of directors, exercised the powers of the board when it was not in session. Authority to make such a delegation of power had been given to the board by the by-laws, and power to make such by-laws was given to the stockholders by the act of incorporation. At a regular meeting of the stockholders the contract was approved by all the stockholders present, being two-thirds of the entire number. The contract was sufficiently executed to bind the corporation, though it never had been formally ratified by the board of directors, and though the notice of the stockholders' meeting made no mention of the contract. A contract whereby a railway company lets another company into joint possession of part of its line for 999 years, at an agreed rental, is not, as between the parties, *ultra vires*, where such joint possession does not interfere with the present use of such line by the company that owns it. Specific performance of such a contract may be enforced by a court of equity. Where such a contract was fairly entered into, and provides for a rental which is nine-tenths of that which the lessor company had previously determined to ask, and the lessee, in reliance on that contract, had abandoned its plans for the construction of an independent line, and has spent more than $1,000,000 in building a road to connect with the leased line, a decree for specific performance should not be refused on the ground that the rental is inadequate, and that the effect of the contract may be to permit disastrous competition between the two roads. Where one railway company owns substantially all the stocks of another railway company, a lease of the latter's line for rent to bepaid to the former company is not void for want of consideration, since it amounts merely to an agreement to pay the rent directly to the stockholders. (Chicago, R. I. & P. Ry. Co. v. Union Pac. Ry. Co., Cir. Crt. of the U. S., Dist. of Neb., 47 Fed. Rep., 15.)

Suggestions as to the Selection of Sources of Water Supply.*

In selecting a source of water supply it is essential that all water should be rejected which is seriously polluted with domestic sewerage. Three are other waters not so polluted, as, for instance, those having a disagreeable taste and odor or drawn directly from swamps, which are manifestly unfit for drinking. A water may also be rejected by reason of its extreme hardness, which makes it unsuitable for washing purposes and for use in boilers. Among the waters which may be used there is a large difference in quality, and this in connection with the quantity and cost should receive careful consideration in making the selection.

Sources may be divided into two general classes, those in which the supply is taken from the ground, known as ground waters, and those obtained from lakes, ponds, streams and storage reservoirs, known as surface waters.

The prominent characteristic of ground water is freedom from color and organic matter (including microscopic organisms), while surface waters are frequently colored with vegetable matter derived from swamps, and almost always contain a greater or less number of microscopic or larger organisms, which, when abundant, frequently impart to the water a disagreeable taste and odor.

With regard to the question of quantity, sufficient surface water can be obtained for the largest cities, and the amount which can be obtained from a given watershed can be estimated in advance with a large degree of accuracy. Ground water supplies, on the other hand, are much more limited in quantity, and the amount to be obtained from any given place cannot be as accurately predicted.

As a whole we may say that when unpolluted ground water can be obtained in sufficient quantity from regions where the water does not dissolve much mineral matter, and in this way become hard, it is very much to be preferred to surface water for the supply of a city or town.

With these general statements we will proceed to consider in greater detail the quantity and quality of water to be derived from surface and ground water sources, including among the ground waters those taken from wells and filter galleries built beside streams and ponds, and deriving their water, in part, from these surface waters by filtration.

The question of the *quality* of waters variously situated has been so fully treated in the special report of the Massachusetts State Board of Health, Part I., 1890, that the present article will give greater prominence to the *quantity* of water to be obtained under different circumstances.

Quantity of Surface Water.—All sources from which water is obtained depend for their supply upon the rain which falls upon the area from which the water can flow over the surface or under ground to the point whence it is taken for use. In a great majority of cases this area coincides with the superficial watershed of the stream or pond utilized. We have, therefore, as very important factors affecting the quantity of water, the amount of the annual rainfall and the area of the watershed.

The whole of the rain which falls upon a watershed does not flow off into the streams, because much is lost by evaporation from the surface of the ground. The amount of this loss has been determined practically by comparing the quantity of water falling upon a given water-shed (as deduced frem the depth of rainfall and the area of the watershed) with the amount of water flowing off in the streams. Very valuable records of this character have been kept by the city of Boston for many years at Cochituate Lake, Sudbury River and Mystic Lake, and the results have been published in the annual reports of the Boston Water Board. From these we learn that the average percentage of rainfall collected from these three watersheds is as follows:

	Average Rainfall. In.	Average Rainfall Collected. In.	Per Cent. Collected.
Lake Cochituate (28 years' observations)	47.82	20.55	42.97
Sudbury River (16 years' observations)	45.80	22.67	49.50
Mystic Lake (13 years' observations)	44.11	20.22	45.84

In attempting to determine the quantity of water which can be made available for use from any given source, the above figures, representing the average results of many years' observations, have only a limited value, because there is a marked variation in the amount of rainfall in different years and a still greater difference in the amount of rainfall collected, the rule being that the percentage collected decreases with the amount of the annual rainfall; moreover, there is a vast difference in the amount of rainfall collected at different seasons of the year. In view of these differences it is obviously necessary to take into account the rainfall collected during dry periods of much less than a year's duration. This can be done by means of the records of the Boston Water Works above referred to. Of these the Sudbury River records are the most accurate and the most generally applicable to conditions existing at other places, and, on account of their value as a basis for water supply estimates, they are reproduced* from the reports of the Boston Water Board in the following table. The rainfall collected is also shown graphically.

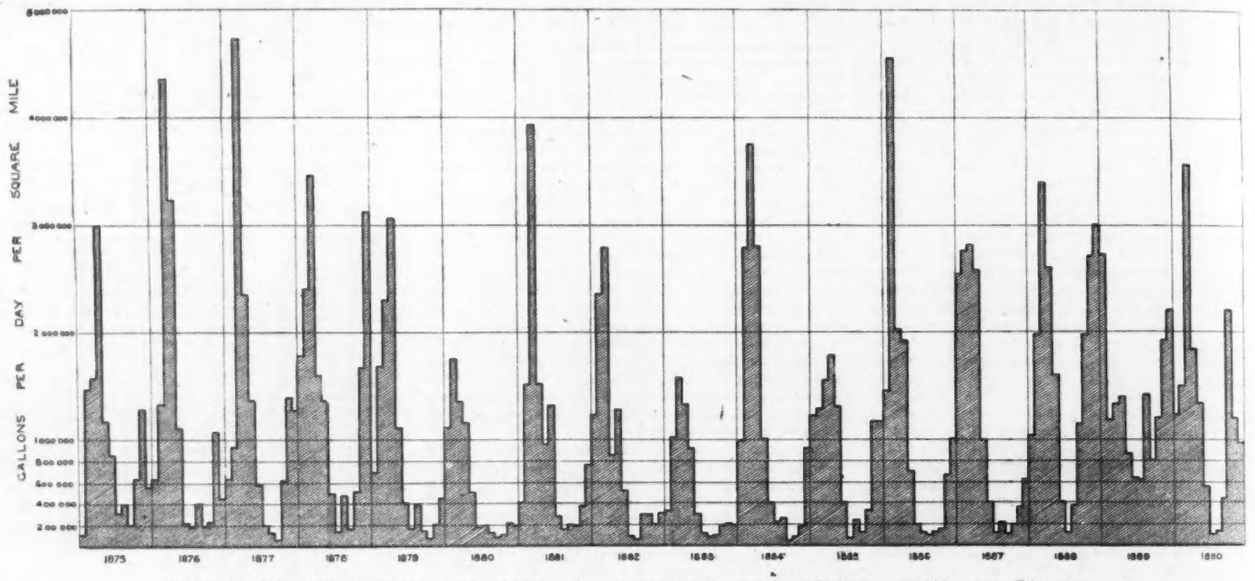


DIAGRAM SHOWING RAINFALL COLLECTED ON SUDBURY RIVER WATERSHED FROM 1875 TO 1890.

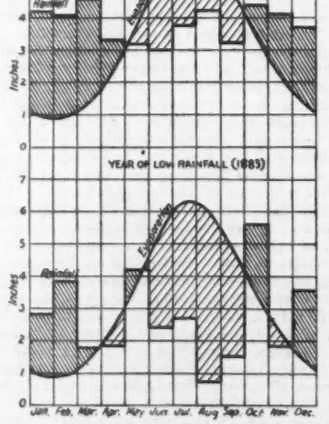


Diagram Showing Relation of Evaporation to Rainfall.

(Fine hatching indicates excess of rainfall; coarse hatching shows excess of evaporation.)

The most prominent feature of the table and diagram is the immense difference in the amount of water collected in the spring and in the summer; but the difference between the flow of different years is also very great. The dryest years were 1880 and 1883, in each of which there was a severe drought during the last seven months, and even during the spring of each of these years the amount collected was much less than in other years. The summer of 1889 was in marked contrast with all of the others, the flow being unprecedentedly high.

As has already been indicated it is necessary in estimating the capacity of sources of water supply to take into account the driest periods which have occurred, and which consequently may recur; and for this reason it is the minimums recorded in the foregoing table which have the most value.

With such a vast difference in the average daily flow during the driest month and the driest year, and also in the flow during the driest year and a long series of years, it is obvious that the quantity of water which can be made available from a given watershed depends very much upon the amount which can be stored in seasons when water is abundant for use during seasons of drought.

It is feasible to deduce from the Sudbury River records a table which will show directly the amount of storage necessary to make available different quantities of water per day from each square mile of water shed,* where the conditions are similar to those which exist at Sudbury River. A table of this character is given below, which, in addition to the amount of storage required, gives the length of time the reservoir would have been below high water mark during the driest period of the given duration, and the date when the water in the reservoir would have reached its lowest level.

Having deduced from the Sudbury River records the facts given in the last table, we have next to consider to what extent they are applicable to other watersheds. It may be said in a general way that the dry weather flow of different streams per square mile of watershed, without artificial storage, is liable to differ greatly; but that the total yearly flow does not vary nearly as much. In many cases it will be found, by applying the Sudbury River records directly, that there is so great a difference between the estimated yield and the amount of water required that any further refinement is unnecessary. In

* By FREDERIC P. STEARNS, Engineer of the Mass. State Board of Health. From the annual report of the Board for 1890. These suggestions are based mainly upon observations in Massachusetts, and, in some respects, will be inapplicable to other places where different conditions prevail.

* This table is omitted, but the graphic diagram shows the general results.—ED. ENG. NEWS.

other cases it is necessary to take into account everything which may affect the application of these records. The chief causes of variation in the yield of different watersheds per square mile, after taking into account the influence of storage, are: the amount of rainfall and its distribution throughout the year, the area of water surfaces, the character of the surface of the ground as regards topography and material, and the size of the watershed. There is also another feature which frequently requires consideration, particularly with small and steep watersheds; namely, the loss of water by leakage past dams, and by filtration through the ground to a lower level.

The conditions which existed upon the Sudbury River watershed during the time included in the records were as follows: The area of watershed from which the flow was measured was 77.764 square miles until the end of 1878, then 78.238 square miles until the end of 1880, and after that time 75.199 square miles. These areas include all water surfaces. From the beginning of the observations until the end of 1878, the water surfaces consisted of Farm Pond, Whitehall Pond (which was flowed in winter and drawn down in summer), several mill ponds, and the various streams. The area of these combined water surfaces was equal to 1.02% of the land surfaces. The construction of artificial storage reservoirs has since increased the area of water surfaces. Three reservoirs were completed and filled in 1879, making the total area of water surfaces after this date, until 1886, 2.31% of the land surfaces. In 1886, Reservoir No. 4 was added, increasing the per cent. of water surfaces to 2.92. The dryest periods occurred between the years 1879 and 1886, and it may therefore be assumed that the water surfaces of Sudbury River which had the most effect upon the present records were 2.31% of the land area.

The flow of the river past the lowest dam has been greatly modified by the use of the artificial reservoirs; but this does not appear in the records, because the amount flowing past the dam is corrected by the amount added to or drawn from storage. The object in making these corrections has been to eliminate the effect of the reservoirs and to present in the records the natural flow of the stream modified only by such storage as is furnished by ordinary mill ponds and by Whitehall Pond. It cannot, however, be said that the effect of the reservoirs is wholly eliminated, because the evaporation from the increased water surfaces is not taken into account; and the dry weather flows recorded are consequently less than they would be if these reservoirs did not exist.

The average annual rainfall upon the Sudbury River watershed is nearly the same as that in other parts of the State, so that it is not often necessary to take into account any difference of this kind.

The watershed of the Sudbury River contains many hills with steep slopes, some of which are used for pasturage and others are covered with a small growth of wood. The valleys, as a rule, are not steep, and there are extensive areas of swampy land, generally covered with a growth of brush and trees. The hills are, for the most part, of rather impervious clayey material, containing boulders, while the flat land is sandy and in some cases gravelly.

The special characteristics of the Sudbury River watershed have thus been described in detail, so that in applying the results to other watersheds such modifications could be made as would be rendered necessary by the difference in conditions.

In this paper further consideration will be given only to the effect of a varying percentage of water surfaces upon the yield of watersheds, and to the flow during short periods of drought.

With regard to the effect of water surfaces it has been a common practice to leave them out of consideration in estimating the area of a watershed, upon the assumption that the evaporation from water surfaces offsets the rainfall upon them. The Sudbury River records, however, were not made upon this basis, and they are therefore strictly applicable only to water sheds which have the same proportion of water surfaces unless a correction is made for evapotation.

For determining the amount of evaporation, the most valuable information is to be obtained from the paper* presented by DESMOND FITZGERALD, C. E., to the American Society of Civil Engineers, based upon experiments made upon the Boston water-works, chiefly at Chestnut Hill Reservoir, Boston. In his paper, as the result of several years' experiments, a mean evaporation for each month of the year is given. By comparing this with the mean rainfall for each month, we can obtain the relation between evaporation and rainfall in an ordinary year; and as the evaporation does not vary very much from year to year, we can also obtain approximately the relation between the evaporation and rainfall in a dry year, by comparing the average evaporation with the rainfall in a dry year like 1883.

The results of these comparisons are shown by the accompanying table and diagram.

It will be seen from the facts presented that the monthly rainfall varies much less during the year than the evaporation; also that in an average year the rainfall is 6.68 ins. greater than the evaporation. The average year may be divided into two periods, one extending from May to September, inclusive, in which the evaporation is 8.77 ins. greater than the rainfall; and the other extending from October to April, inclusive, in which the rainfall exceeds the evaporation by 15.45 ins.

In the year of low rainfall the evaporation was 6.34 ins. greater than the rainfall. During the warmer months, from April to September, inclusive, the excess of of evaporation was 15.22 ins., and during the other six months the rainfall was 8.88 ins. in excess of the evaporation. These figures indicate that a pond will not lower by evaporation in a dry summer more than about 15 ins., even if it receives no water from its watershed.

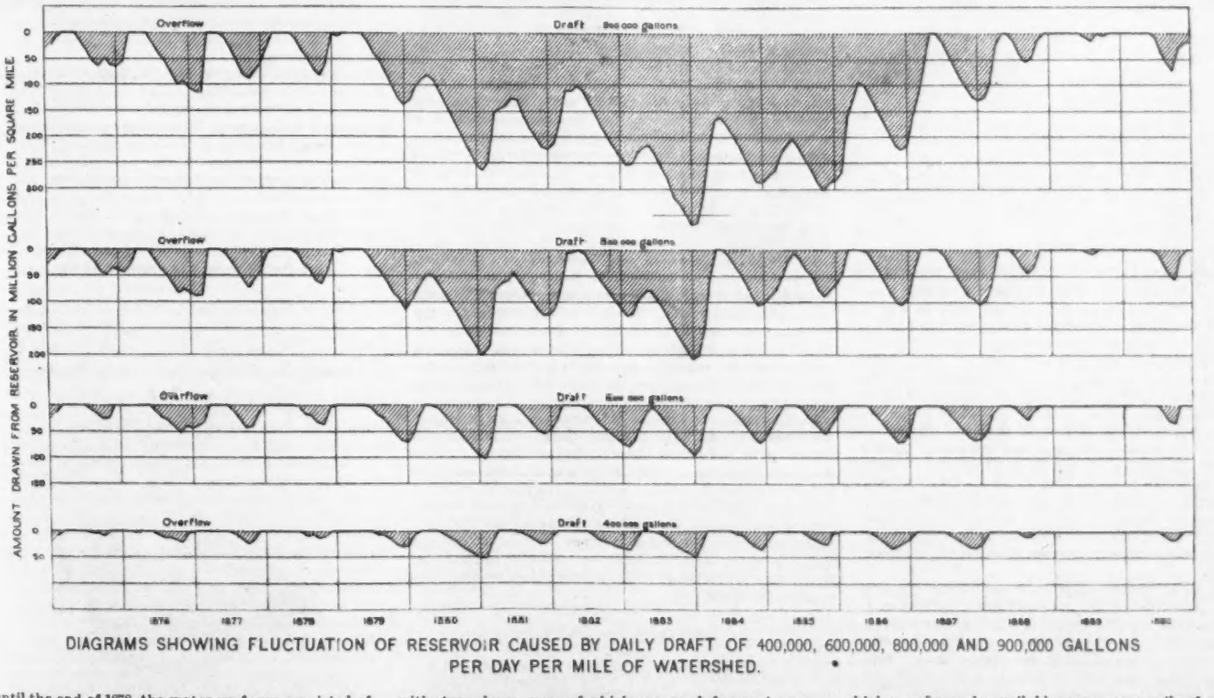
In order to present in the most convenient form the yield of watersheds per square mile, the following table has been prepared, which gives the quantity of water which may be made available per square mile of watershed (estimating land surfaces only), with varying amounts of storage and a varying percentage of water surfaces. In preparing the table the records of the flow of Sudbury River and of the rainfall upon the Sudbury River watershed from 1875 to 1890, inclusive, have been used; also the records of evaporation from water surfaces from observations made chiefly at Chestnut Hill reservoir during the years 1876 to 1880 and 1885 to 1887. For other years, when the evaporation was not measured, the average evaporation, has been used. The flow per square mile is in all cases the smallest recorded

TABLE SHOWING THE AMOUNT OF STORAGE REQUIRED TO MAKE AVAILABLE DIFFERENT DAILY VOLUMES OF WATER PER SQUARE MILE OF WATER-SHED,† BASED UPON THE RECORDS OF THE FLOW OF SUDBURY RIVER FROM 1875 TO 1890, INCLUSIVE.

Daily vol'me per square mile. Gallons.	Storage required per Square Mile to prevent a Deficiency in the Season of the greatest drought when the daily consumption of water is as indicated in the first column. Gallons.	Dates when greatest draft from reservoir would have occurred during the period. 1875-1890. Beginning of draft upon reservoir.	Lowest point reached.	Reservoir full again.	Length of time reservoir would have been below high water mark.
100,000	2,200,000	Sept., 1884.	Oct., 1884.	Nov., 1884.	3 months.
150,000	5,300,000	Sept., 1884.	Oct., 1884.	Dec., 1884.	4 months.
200,000	11,000,000	June, 1880.	Dec., 1880.	Feb., 1881.	9 months.
250,000	22,000,000	June, 1880.	Dec., 1880.	Feb., 1881.	9 months.
300,000	33,000,000	June, 1880.	Dec., 1880.	Feb., 1881.	9 months.
400,000	54,000,000	June, 1880.	Dec., 1880.	Mar., 1881.	10 months.
500,000	78,000,000	June, 1880.	Jan., 1881.	Mar., 1881.	10 months.
600,000	105,000,000	May, 1880.	Jan., 1881.	Mar., 1881.	11 months.
700,000	156,000,000	June, 1882.	Dec., 1883.	Mar., 1884.	1 year 10 months.
800,000	214,000,000	June, 1882.	Dec., 1883.	April, 1884.	1 year 11 months.
900,000	373,000,000	June, 1879.	Dec., 1883.	May, 1887.	8 years.
1,000,000	540,000,000	June, 1879.	Dec., 1883.	Mar., 1890.	10 years 10 months.
1,024,000	596,000,000	June, 1879.	Oct., 1885.	May, 1890.	11 years.

* The area of the Sudbury River watershed, as used for making up the records, includes both land and water surfaces.

† Including water surfaces amounting to 2.31 per cent. of the land surface.



DIAGRAMS SHOWING FLUCTUATION OF RESERVOIR CAUSED BY DAILY DRAFT OF 400,000, 600,000, 800,000 AND 900,000 GALLONS PER DAY PER MILE OF WATERSHED.

* Evaporation, by DESMOND FITZGERALD, C. E., Transactions of the American Society of Civil Engineers, Vol. XV., 1886, p. 581.

after taking into account the evaporation from water surfaces.

TABLE SHOWING RELATION OF EVAPORATION TO RAINFALL.

NOTE.—+ indicates excess of rainfall; — indicates deficiency.

MONTH.	Average Year.			Year of low rainfall.		
	Rainfall.	Evaporation.	Excess or deficiency of rainfall.	Rainfall.	Evaporation.	Excess or deficiency of rainfall.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	4.18	0.98	+3.20	2.81	0.98	+1.83
February	4.06	1.01	+3.05	3.86	1.01	+2.85
March	4.58	1.45	+3.13	1.78	1.45	+0.33
April	3.32	2.39	+0.93	1.85	2.39	−0.54
May	3.20	3.82	−0.62	4.18	3.82	+0.36
June	2.09	5.34	−2.25	2.40	5.34	−2.94
July	3.78	6.21	−2.43	2.68	6.21	−3.53
August	4.23	5.97	−1.74	0.74	5.97	−5.23
September	3.23	4.86	−1.63	1.52	4.86	−3.34
October	4.41	3.47	+0.94	5.60	3.47	+2.13
November	4.11	2.24	+1.87	1.81	2.24	−0.43
December	3.71	1.58	+2.33	3.55	1.38	+2.17
	45.80	39.12	+6.68	32.78	39.12	−6.34

TABLE SHOWING THE AMOUNT OF STORAGE REQUIRED TO MAKE AVAILABLE DIFFERENT DAILY VOLUMES OF WATER PER SQUARE MILE OF WATERSHED (ESTIMATING LAND SURFACES ONLY), CORRECTED FOR THE EFFECT OF EVAPORATION AND RAINFALL ON VARYING PERCENTAGES OF WATER SURFACES, NOT INCLUDED IN ESTIMATING THE AREA OF THE WATERSHED.

Daily volume in gallons per square mile of land surface.	STORAGE REQUIRED IN GALLONS PER SQUARE MILE OF LAND SURFACE TO PREVENT A DEFICIENCY IN THE SEASON OF GREATEST DROUGHT WHEN THE DAILY CONSUMPTION IS AS INDICATED IN THE FIRST COLUMN, WITH THE FOLLOWING PERCENTAGES OF WATER SURFACES.				
	0 per ct.	3 per ct.	6 per ct.	10 per ct.	25 per ct.
100,000	556,000	3,000,000	8,800,000	.....	.....
150,000	3,460,000	7,100,000	13,400,000	.....	.....
200,000	9,400,000	11,700,000	18,000,000	.....	.....
250,000	19,000,000	22,500,000	25,400,000	.....	.....
300,000	29,800,000	33,000,000	36,100,000	.....	.....
400,000	52,000,000	54,400,000	57,500,000	.....	.....
500,000	76,500,000	77,300,000	80,300,000	.....	.....
600,000	104,000,000	104,800,000	107,100,000	112,800,000	.....
700,000	144,400,000	153,000,000	167,400,000	170,700,000	215,900,000
800,000	202,300,000	210,900,000	219,500,000	228,600,000	273,800,000
900,000	346,200,000	349,200,000	352,200,000	353,900,000	381,600,000
1,000,000	514,600,000	516,700,000	519,700,000	523,600,000	532,200,000

The table shows that a daily yield of 1,000,000 galls. per square mile of land surface can be made available when there is a very large amount of storage, such as may be found in some instances where a large pond is fed by a very small watershed. To obtain this quantity, however, would require the reservoir to be below high water mark for 11 years; and during a considerable portion of the time the water would not rise nearly to high water mark, even in the spring. In practice this would be objectionable, as it would permit the growth of weeds, grasses and bushes on the exposed shores of the reservoir. Taking everything into account it may be said that the greatest amount which can be made practically available from a square mile of watershed does not exceed 900,000 galls. per day, and the cases are very rare in which more than 600,000 galls. per square mile per day can be made available when it is necessary to store the water in artificial reservoirs.

As a matter of theoretical interest only, it may be said that to make available the average yield of the Sudbury river watershed for the entire 16 years (1,079,000 galls. per day per square mile) would require a storage capacity of not less than 725,000,000 galls. per square mile. This is about six times the amount of storage which it is now considered feasible to provide on this watershed.

The amount of water which can be made available from a given watershed will not always depend upon the quantity of water which can be stored, because considerations of quality require that the levels of the reservoir should not be made to fluctuate too much, and that the reservoir should not be drawn below high water mark for too long a time.

The diagram given has been prepared from the Sudbury River records to show the fluctuations of a reservoir from which various quantities of water—namely, 400,000, 600,000, 800,000 and 900,000 galls. per day per square mile—are drawn. The dotted lines marked "overflow" represent the full reservoir. Where the full lines fall below the dotted lines a draft upon the reservoir is indicated, the amount of which in gallons of storage per square mile is shown by the scale given on the diagram. It will be seen that a consumption of 800,000 or 900,000 galls. per day per square mile causes a reservoir to be drawn below high-water mark for many years at a time, which could hardly be permitted except in the case of a natural pond with gravelly shores.

The application in actual practice of the table may be better understood by giving an example. Let us assume that it is desired to know the yield of a pond having an area of .15 of a square mile and an available storage capacity of 225,000,000 galls., which has draining into it 1.5 square miles of land surface. The amount of storage in this case would be equivalent to 150,000,000 galls. per square mile of land surface, and the water surface would equal 10% of the land surface. By looking in the column of the table headed 10% it will be seen that a storage of 150,000,000 galls. per square mile corresponds to a daily volume of between 600,000 and 700,000 galls. per square mile, or more exactly by proportion to 660,000 galls., equal to 990,000 galls. daily for the whole watershed. The results obtained by this method will in some cases be practically correct. In other cases it will be necessary to take account of local conditions, prominent among which may be leakage past a dam or filtration through the ground to lower levels; and the application of judgment will often be necessary to determine whether the watershed under consideration will yield the same or a greater or less amount per square mile than that of the Sudbury River.

The only point remaining to be considered with regard to the quantity of surface water relates to the flow from watersheds during short periods of extreme drought. The flow during such periods is chiefly of importance when it is desired to know the minimum flow of streams on which little or no storage can be obtained. On such watersheds the water surfaces are generally insignificant, so that the Sudbury River records are not applicable unless they are corrected for evaporation. It is well known that the natural dry weather flow of streams per square mile depends much upon the *extent* of the watershed; because it is frequently observed that streams draining but a small area dry up in summer while those draining large areas continue to flow, though with a greatly reduced volume. There is also a large variation in the dry weather flow from watersheds of the same size due to the amount of water stored in the ground and subsequently coming out in the form of springs. The records of the natural flow of streams in a very dry period are very meagre. The lowest flow of the Sudbury River occurred during the month of September, 1884, and averaged only 44,000 galls. daily per square mile of watershed. Correcting for the excess of the evaporation from water surfaces over the rainfall upon them, we obtain 97,000* galls. per square mile as the amount that the flow would have been if there had been no water surfaces. The next lowest monthly record was in September, 1877—60,000 galls. per square mile. At this date the reservoirs had not been constructed and the area of water surfaces to be corrected for evaporation was smaller. Making the correction, we have as the flow per square mile 82,000 galls. per day.

It should be remarked with reference to the figures which have been given that the Sudbury River records represent the average flow for a month, while the other measurements represent the flow at one time only. On the other hand the Sudbury River measurements represent the dryest periods occurring in 16 years, while the other measurements, although taken at times of very low flow, do not probably represent the dryest periods which occurred.

Judging from the few measurements which are available it seems fair to infer that the minimum flow from a square mile watershed without storage will not, under favorable conditions, exceed 80,000 galls. daily; and that under conditions frequently met with the flow may not be more than half of this amount; or with very small watersheds it may be nothing at all, as in the case already cited of streams which run dry in summer. These statements do not, however, apply to the larger streams, such as the Connecticut, Merrimack and Chicopee rivers, which have a larger minimum flow.

Railways in India.

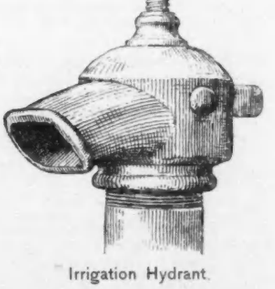
A paper by Mr. D. FURNIVALL, on "Indian Railway Communication," was presented at the last meeting of the British Association. It gave a short history of railways in India since the commencement, about 40 years ago, and stated reasons for the adoption of the metre gage in 1871. At the end of 1890, about 16,277 miles were open for traffic, of which two-thirds were of the Indian standard gage of 5 ft. 6 ins., and the remainder of metre gage. The cost has been about $69,000 per mile for the former and $25,000 per mile for the latter, but no allowance has been made in the capital account for the variation in value of the rupee, which has ranged between 52 and 32 cts. during the past 40 years. The railways paid last year over 4⅜% on the capital expenditure in rupees.

The Indian railways have been well laid out and are well built, but the introduction of a brake of gage must be viewed as a misfortune. Passenger fares and goods rates are sufficiently low to attract traffic and promote trade with England, especially that of a supply of wheat; and the demands of Indian railways on England for iron and steel equalled about one-tenth of the whole English exports last year. A comparison was made between the rate of development of railways in the United States and India per unit of population, but it would evidently be absurd to imagine conditions in India which would cause the profitable development of railways at the rate maintained during recent years in the United States. The question arises, however, have the English done enough in India? The latest records show that the population has increased by 29,000,000 within the last decade, and it may reasonably be anticipated that increase in the future will be progressive. Accounts show that a reasonable return for railway investments has been obtained, and that the older lines are earning handsome dividends. Experience indicates that the development of Indian railways opens an important field of demand in the iron and steel industries of England, and furnishes a supply of wheat, the price of which competes with America and Russia, so that the cost of bread to the English consumer may be regulated. Experience also shows that railways in India have done much to awaken the people to new lights and a sense of new responsibilities, which tend to the obliteration of old superstitions and the generation of loyalty toward the central governing power. Up to the present time practically all railways constructed in India have been obtained by English capital, guaranteed to pay a certain percentage by the Secretary of State, and consequently progress has been slow. India is poor, and the trading classes do not accept railway investments, but now that the circumstances of India are known in England, and now that records show that reasonable returns can be obtained if the railway routes are selected with intelligence, even on the depreciative value of the rupee, because its relative value has only changed in regard to gold, not as regards grain or labor, in India, the question arises whether the private enterprise of England cannot lift this burden from off the shoulders of the Government and be induced to supply capital without the trammels of a Government contract.

Sir GUILFORD MOLESWORTH, M. Inst. C. E., in discussion, said the paper seemed to show that the development of India by railways had been quite inadequate to the vastness of the country. India possesses immense natural wealth and resources, the development of which will make it far more prosperous than it is. Labor is cheap, and the soil for the most part very productive. Properly managed, India should be a source of immense wealth to England, but much of the trade which should flow from it has been thrown into the hands of the Russians.

The California Irrigation Hydrant.

With the introduction in this country of pipe lines for distributing water for irrigation, whereby the waste may be saved which accompanies open canals and flumes, irrigation hydrants have become a necessity. A simple hydrant, which may be sold at a low figure and is easy of attachment, is shown by the accompanying cut.



Irrigation Hydrant.

The head of the hydrant is cast in one piece, with an oval spout, through which the valve is inserted for connection with the stem. The screw stem is of heavy brass and is attached to the valve plate by a swivel joint to prevent the grinding of the gasket on the valve seat. An attachment for locking is provided at the back of the valve. The hydrant is

* This quantity is somewhat larger than it should be, as no account is taken of the water which came from the ground adjoining the reservoirs as they were being drawn down to supply the city.

furnished with or without a wrought iron standpipe and T for connection with the pipe line, and is made by the Lacy Manufacturing Co., Los Angeles, Cal.

Cable Railways of Los Angeles, Cal.

The following description is taken from the report on cable railways presented at the recent convention of the American Street Railways, at Pittsburg, by Mr. J. C. ROBINSON:

In July, 1886, two short, single track cable roads of about 7 miles in length were brought into operation on Temple St. and Second St., but the inauguration of the great system in Los Angeles virtually dates from 1888. The Pacific Railway Co. now owns and operates a total mileage of 20¼ miles, traversing the leading thoroughfares of the city, and Temple St., 4¾ miles, has recently been double tracked. The project was conceived with great boldness in view of the population the roads were intended to serve. In 1880 Los Angeles had a population of 7,500 only, which in 1888 had risen to 65,000, and on the completion of the work in 1890 to 80,000.

The bridges and viaducts, three in number, built specially to carry the cable railway, form special features of the system. One viaduct, 578 ft. long, carries the line over the track of the Santa Fé railway and river in one span. In all, the length of bridges and viaducts thus specially built amounts to 4,250 ft., and the greatest, on San Fernando Ave., carrying the cable road over the depot of the Southern Pacific Co., measures 1,535 ft. This viaduct carries, like the others, a double track, but owing to difficulties as to the site for supports between the railway tracks below, it rests on single posts, being the only case in which double tracks are so carried. [ENGINEERING NEWS, Jan. 25, 1890.] Of the total length of 1,535 ft., 50 ft. at each end form the concrete approaches, and the remaining 1,435 ft. are all in metal work; the dimensions generally are as follows: Height from ground to rail level, 25 ft. 9 ins.; width between hand rails, 25 ft., main posts 5 ft. wide at ground line tapering to 14 ft. above the ground, and 22 ft. long. There are 19 main posts, each weighing 4½ tons; 10 smaller ones 12 ins. square and 26 ft. long. The ruling span is 50 ft., but 2 spans are 55 ft., 3 of 40 ft., 1 of 30 ft. and 1 of 20 ft. The main trusses are of the Warren type, 4 ft. deep, weighing 100 lbs. per running ft.; the concrete approaches are 8 ft. high at the highest point, and 19 ft. wide. Two curves on the viaduct are 60 ft. radius. There is no thoroughfare on the viaduct except for the cable trains, owing to the grade of the approaches, 20%, and, as a consequence, the cable is not here enclosed in a conduit.

The driving plant is placed in three power houses, the weight of machinery being, in Grand Ave., approximately 549 tons, at Boyle Heights 448 tons and in Downey Ave. 446 tons. In principle, capacity and general arrangement the engines, etc., are the same, so that a notice of the Grand Ave. power house plant will suffice. The boilers are of the Hazelton tripod type, occupying small superficial area and giving a maximum heating effect. The Roney mechanical stoker and smokeless furnace are used. The engines are double expansion, high-pressure cylinders, 26 × 48 ins., low pressure, 42 × 48 ins. The high-pressure transmits power to a double disk and the low pressure to a single disk crank, and the engines develop a minimum of 700 HP. at 75 revolutions a minute. The cylinders are parallel, with 10 ft. distance centers. The main journals are 12 × 28 ins., outboard journal 12 × 20 ins., low-pressure crank pin, 7 × 7 ins. and high pressure 12 ins. diam. and 7 ins. long. The fly-wheel is 14 ft. diam., with 14-in. face, weighing 36,000 lbs. The main driving shaft, which is 18 ft. 2½ ins. long, communicates power to the car machinery by the system of endless cotton rope. On the shaft are two wheels 6 ft. 2 ins. diam., each grooved for fourteen 2-in. cotton ropes, these ropes giving movement to the driving wheels 25 ins. diam., similarly grooved, the shaft on which these latter turn being coupled to the driving winder shaft of the cable machinery by Oldham couplings. The rope drums receiving power from the large driving wheels are 15 ins. diam., and they are coupled by ropes working on the grooves on their rim, to two "idler" rope wheels in rear, these "idler" wheels subserving a valuable purpose in the economy of the design. They are 1 in. less in diameter than the companion rope wheels, and the result of this is that the cable itself has no labor in driving the "idlers," the slip required being otherwise provided. The cable drums are 13 ft. diam., grooved for five 1¼-in. ropes, run loose on the shaft alongside the hub of the driving wheels and receive motion by the action of friction disks on the Weston principle. A speed of 75 revs. per minute on the engines represents a traveling speed of 8 miles an hour on the road. The road is 3 ft. 6 ins. gage, double track throughout. The rails are of steel girder pattern, 40 lbs. per yd., the slot rails being of the same weight. Yokes of wrought iron, weighing 200 lbs. are laid at a distance of 3 ft. 6 in., and the conduit, 28 ins. deep, is of concrete, and averages 12 ins. in thickness. Covering plates are used. The surface is paved to level with bituminous rock, a Southern California asphaltum product. The carrying pulleys, 16 ins. in diameter, are of cast iron, unlined, mounted in lignum vitæ, and placed 30 ft. apart. The curve pulleys are also of cast iron 18 and 22 ins. diameter, with centers 4 ft. apart. The entire length of straight surface track of cable lines is 99,328 ft.; viaducts, 4,250 ft.; bridges, 2,124 ft.; curves, 2,110 ft.; pits, 562 ft.; making a total of 108,274 ft. of track, or rather over 20½ miles. The cost of construction amounted to about $52,500 per mile of single track complete. The varieties of level, including those caused by the approaches to the viaducts and bridges, necessitated the use of depression and crown pulleys, and several steam railway and cable road crossings had also to be provided for. The cables are of crucible steel, 1¼ ins. diameter, weighing 2½ lbs. per ft. The average weight per mile is 6.58 tons (2,000 lbs.), and the price averaged about 12½ cts. per lb. The total cost for construction and equipment was about $1,715,500.

The Los Angeles road, having numerous sharp curves in parts, is pretty severe on the 7 cables in use, their life averaging about 10 months only. The cost of coal fuel ($10.50 per ton) and the number of power houses made the initial operating charges rather high, but the substitution of crude oil for coal as fuel has materially reduced these expenses. The cars are run in trains of 1, 2 or 3 trailers to a grip car, 2½ and 5 minutes headway, each train averaging 100 miles per day of 18 hours. The speed of the cables averages 8 miles per hour. The system presents many curves of every type and character. In the first section operated, 15,000 ft., there are 14 right angle compound and reverse curves, and yet the facility and safety with which these roads have been operated are gratifying, as far as overcoming practical difficulties are concerned.

PERSONALS.

Mr. JOHN S. WATTLES, General Manager of the Sioux City Elevated Ry. & Rapid Transit Co., Sioux City, Ia., has resigned.

Mr. H. F. FORREST, formerly of Winnipeg, Man., has been appointed Chief Engineer of the Great Northwest Central Ry., Canada.

Mr. A. P. KITCHING has resigned as General Manager of the Bear Valley Irrigation Co. and has been succeeded by Mr. R. J. WATERS.

Mr. H. W. HAMMOND has resigned his position as Superintendent of the Eastern Division of the Rome, Watertown & Ogdensburg R. R.

Mr. CHARLES H. WIGGIN has been appointed Master Mechanic of the Boston & Maine R. R., in charge of the motive power and car department.

Mr. JOHN DORSEY has been appointed Assistant Superintendent of the Rocky Mountain division of the Northern Pacific R. R., with headquarters at Wallace, Idaho.

Mr. JOHN BAIRD, at one time manager of the Metropolitan Elevated road in New York and subsequently Manager of the Burden Iron Works, Troy, N. Y., died in New York last week.

Mr. SAMUEL W. FRESCOLN, at one time connected with this journal, and a graduate of Lehigh University, has opened an office as engineer and contractor in the *World* Building, New York City, his specialties being iron and steel structures, water-works, sewerage, electric and cable plants, &c.

Mr. WILLIAM M. PARKER died in Manchester, N. H., Oct. 29, at the age of 70. He had been in the railway business since 1841, having been Assistant Superintendent of the Hudson River road, Superintendent of the Northern of New Hampshire, Boston, Hartford & Erie (now the New York & New England), Passumpsic, Boston & Lowell, and Connotton Valley roads.

Mr. JOEL B. HARRIS, who died at his home in Rutland, Vt., last week, was born at Sterling, Conn., in 1832. He was engaged as a civil engineer from 1842 to 1853, and as a railway contractor from 1853 to 1860. He built large sections of the New York & New Haven, the Boston & Albany, the Harlem and other roads. He went to Rutland in 1860, where he was engaged in the car-wheel and general foundry business.

Mr. LEWIS LYON, President of the Third Ave. R. R. Co., New York, died in this city Oct. 29 at the age of 61. He was born in Birmingham, England, graduated at the University of the City of New York and went into the railway business. He became Treasurer of the Third Ave. R. R. Co. in 1876, and President in 1879. He was instrumental in introducing the cable system into New York, about 1886, on the Tenth Ave. line, and later in the change of the Third Avenue line to this system, work upon which is now in progress.

NEW PUBLICATIONS.

—*November Magazines.*—The literary magazines this month have more articles of technical interest than for some time. *Harper's* has two papers which deserve comment one on the prospects of civilization in Africa, whose importance is such that we shall abstract it in our next issue, and a popular description of railway building in the far West by JULIAN RALPH. The latter paper is entitled "Dan Dunn's Outfit," and it gives the impressions of a magazine writer who makes a tour over a branch of the Canadian Pacific, now in process of construction in the Kooteny mining district of British Columbia. They are familiar enough scenes to many engineers, which Mr. RALPH pictures; but we are often most interested in descriptions of things with which we are most familiar, and engineers will find the picturesque description of engineers' and contractors' life in the wilderness worth the reading.

—*Scribner's*, which has had few articles of technical interest of late, appears this month with several live papers worth comment here. The number opens with a paper by CARL LUMHOLTZ (the first of a series) describing explorations of the Sierra Madre Mountains in Northern Mexico. Ethnological and archæological discoveries were the chief objects of the expedition; the Sierra Madre having been for many years the home of tribes of cliff dwellers, closely related to the Zuni and Moqui Indians of New Mexico. The series of articles on ocean steamships has for this month's installment a paper on the ocean steamship as a freight carrier, which describes in a popular way the growth of ocean commerce by steam, and the gradual disappearance of the sailing vessel except for voyages of extreme length. The latter part of the paper is devoted to a pretty strong argument for subsidies to United States ships, a topic which several writers in other magazines also discuss this month. The proposed Trans-Saharian Railway is described in an enthusiastic paper by NAPOLEON NEY. But it must be confessed that the outlook for the scheme is hardly a promising one. French investors who were so badly deceived when they sent their money to be sunk at plague-smitten Panama will be slow to venture their hard-earned dollars in another enterprise in tropical lands, where insurmountable obstacles may be met. Perhaps the Trans Saharian Railway could be built more easily than the Panama Canal could be dug; but the latter was sure of a large traffic when it was completed, and as much cannot be said of this African railway project. Mr. NEY says, "The exports and imports of the Soudan ought to provide an income of 7,310 francs per kilometre." This would be about $2,350 per mile. Just how he is able to figure so accurately on the probable volume of traffic from a country practically unexplored by Europeans, does not appear.

—The *Century* has less matter of technical importance this month than usual. Engineers will certainly be interested, however, in the paper by JOHN MUIR on "A Rival of the Yosemite," and its magnificent illustrations. The valley to which the author directs attention is on the south fork of King's River, about 45 miles northeast of Visalia, Cal. The valley is about 10 miles long, and half a mile wide, and purplish gray granite cliffs which form its sides rise 2,500 to 5,000 ft. above its floor. The waterfalls are far less striking than in the Yosemite valley, but the mountain scenery seems to be equal or superior. Mr. MUIR advocates the forming of a National Park, to include all these lofty mountain ranges at the head of King's River, since the lumbermen are already making sad havoc with the fine Sequoia groves which cover the valleys and lower slopes of this picturesque region. In an interesting discussion of "The Food Supply of the Future," W. O. ATWATER shows what progress modern science and industry have made toward disproving the Malthusian doctrine that sooner or later starvation will overtake the human race, since its capacity for reproduction and increase is greater than the possible increase in the world's food production. The author is perhaps somewhat optimistic in his ideas of the possibility of food production by synthesis, and of utilizing the energy of winds and rivers and tides in place of the energy stored in coal and wood. Nevertheless, he presents some interesting results of scientific experiment and actual practice in plant culture. In Holland and France 100 acres have been made to yield food for 200 and 300 persons. The same plot of ground is made to yield six, nine, or even twelve crops per annum. This is effected by frequent transplantings of the different growths.

—The *Forum's* most important paper to engineers is on the "Commercial Future of the Pacific States," by WM. L. MERRY, ex-Secretary of the San Francisco Chamber of Commerce. The paper is practically an urgent plea for the construction of the Nicaragua Canal, without which, he says, "the rapid development of wealth, industry and population on the Pacific coast is an impossibility." In view of the wonderful strides in development which California, Oregon and Washington have made during the past five years, this seems to be putting the case a little strong. If these states have been stagnating during the past five years, that fact has not been apparent to most observers.

—*Electricity Simplified.*—The Practice and Theory of Electricity, including a Popular Review of the Theory of Electricity, with Analogies and Examples of its Practical Application. By T. O'Conor Sloane, E. M., Ph. D. New York, N. W. Henley & Co. 12mo, pp. 158, 29 cuts, $1.

"Simplifying" any complex subject is in any proper sense of the term an impossibility, and to this extent the title of this little book is an unfortunate one, and its alleged purpose a failure. What it really does, of course, all it can do in so limited a space, is to present a few elementary facts about electricity and its modern developments,

and a very scanty outline of the present theory of electricity and of the facts by which it is supported. It gives a critical reader an unfavorable impression of the work at the outset to see such an absurd misuse of words in the title. The task before the author of such a work is not to "simplify" a subject which is almost as vast as the universe, but to tell his readers enough about the A, B, C's of his subject to enable them to acquire further knowledge more easily, without having anything to unlearn.

We are pleased to say, however, that the author has succeeded much better in this, his real purpose, than could reasonably have been anticipated from his loose choice of words for a title. His language in the body of the work is in the main clear, and his mental perspective in regard to what to give and what to omit, in the main good. He makes little or no attempt to write down to the level of ignoramuses, but assumes a certain amount of mental cultivation and general knowledge, with no knowledge whatever of electricity. It therefore seems a work well adapted to the requirements of those numerous readers who have been letting electrical development run away from them, so to speak, and who feel a desire to catch up with it and keep a general run of it, but who as yet do not feel the need to thoroughly master its theory and practice. For such this little handbook may fill a void. If it only gives them a thin smattering of knowledge, what it does give them is (so far as we have observed) real knowledge, and hence a foundation on which they can build as much higher as they please. But they will have to build considerably higher to get any broad understanding of any department of electricity.

A similar criticism must be made on an article referring to quite a different subject, "The Profit of Good Country Roads," by ISAAC B. POTTER, Secretary of the New York State Roads Improvement Association. Like the previous writer, Mr. POTTER hurts his case by claiming too much. Road improvement is most desirable wherever the traffic is or will be sufficient to warrant the outlay, as in city and suburban districts and in many thickly settled farming communities. But there are hundreds of thousands of miles of highway in this country which are now as well made and as well kept as the traffic on them will warrant and the taxpayers can afford. In arguing for improved roads the expense of their maintenance must be considered. Mr. POTTER'S figures show that in France, with all the advantages of cheap labor, the annual cost of keeping 130,000 miles of hard roads averages $138 per mile. He also gives the first cost of 40 miles of hard roads in Union County, N. J., at $350,000, or an average of $8,750 per mile. Interest on this sum at 5% would be $437.50 per annum. A conspicuous example of Mr. POTTER'S fallacies is his comparison of highway and railway traffic. He says: "The great volume of internal trade in every State is the common road trade. It exceeds by countless tons the entire freight tonnage of all the railroads combined." While it is of course true that the tonnage of common road traffic is in excess of railway freight tonnage, a fair comparison of the two can only be made on the basis of ton-miles. The average length of haul of railway freight last year was 113 miles according to Poor's Manual. Of course the average length of haul of highway traffic is not more than a tenth, perhaps not more than a twentieth, of this. Under the title "American Shipbuilding and Commercial Supremacy" Mr. C. H. CRAMP, of the well-known shipbuilding firm, argues in favor of Government subsidies to American steamer lines. Contrary to the general belief, Mr. CRAMP states that there is little profit in building Government vessels compared with ships for merchant service. The reasons given are the severe requirements of the Government as to material, workmanship and performance, and the uncertainty of the continuance of and payment for the work.

The *North American Review* presents a symposium on "How to Improve Municipal Government," by ex-Mayor HART of Boston, and the Mayors of Buffalo, St. Louis and Baltimore. Their Honors agree fairly well on the one point that "home rule," or no interference of the state with city affairs, is one important need; and in fact more stress is laid on this than on any other point. The concentration of power in the hands of the Mayor is on the whole favored, although caution in removing the restrictions on his action is generally advised. The lack of interest in municipal affairs by the best class of citizens is referred to as one of the chief causes of inefficient government. Superintendent PORTER of the Census Bureau gives some account of the results arrived at by the census investigation. If the averages thus far found hold good throughout the United States, "there is an existing debt in force of $2,500,000,000 on the farms and homes of the United States. Mr. PORTER believes that the investigation carried on by the "farms, homes and mortgages division" of the Census Office is of more direct and immediate value to the country than all the rest of the census combined, because of the retrenchment and debt purging which will follow public agitation and knowledge of the subject. The President of the New York Chamber of Commerce writes upon "Our Business Prospects" and declares then to be very bright. The conservatism of the past 6 months he thinks is a healthy sign; and except for the danger of free silver coinage he sees no reason to apprehend anything but profitable business activity for a long time to come.

In the *Popular Science Monthly* Mr. W. F. DURFEE concludes his interesting account of the development of American steel manufacture, describing at length the early history of the Bessemer process in this country, on which he is eminently well qualified to write. His description of modern steelmaking plants and processes is also deserving of praise.

A curious fact, related by Mr. DURFEE, and one which seems well nigh incomprehensible to the younger generation of engineers, blest with the advantages of scientific training, is that it is little more than a score of years since the practical value of chemistry was recognized by steel makers. At the time the experimental steel plant at Wyandotte, Mich., was set up, there was no such thing as a laboratory in connection with a steel works in America; the laboratory erected there was the first one in this country in connection with a steel works. As late as 1870 a firm of steel manufacturers in Sheffield, England, issued a pamphlet in which occurs the following: "The application of chemistry to the manufacture of cast steel has not yet met with any success. The analysis of steel is a very difficult process. It has frequently been attempted in Sheffield but never with any practical success." In his second paper on "Lessons from the Census," CARROLL D. WRIGHT presents strong arguments for the establishment of a permanent census bureau, and for a reform in many of the methods at present adopted in the census enumeration.

—*How to Make Inventions*, or Inventing as a Science and an Art. A Practical Guide to Inventors. By EDWARD P. THOMPSON, M. Am. Soc. M. E., &c. New York: D. Van Nostrand & Co. 8vo., paper, pp. 161; $1.

The first impression of this work, which is not entirely removed by reading it, is that its underlying motive is to stimulate a private patent law practice. But if so, this purpose is kept with some success in the background, for the book is on a higher plane than the ordinary run of such publications, and is really readable and instructive. We have little sympathy with its apparent aim, however, to encourage men to deliberately adopt invention as a profession. Not thus have most of the great inventions been made. A few men are born with a genius for invention which nothing can check, like EDISON, MAXIM, GATLING, WESTINGHOUSE, and a long list of others, but as a rule the great inventor is born, not made, beginning in a small way from an impulse to do some one specific thing, like the great author; and he who starts out of set purpose to become either is more apt to become a public nuisance than a public benefactor. The author declares that "if even a single useful invention comes from the perusal of this book," he shall feel that the time has not been spent in vain; but there is another side to this possible useful result which he does not seem to consider. His single useful invention (which may very likely result from the book) will be dearly purchased if he also induces a handfull of crack-brained enthusiasts to waste their life in the pursuit, not of some one single invention which fills their mind, but of invention in the abstract as a profession, which is about as hopeful a means of livelihood as buying tickets in the Havana lottery. There is considerable condensed scientific information in the book, which makes it interesting reading for a spare hour, but the apparent purpose in giving this information, to serve as a sort of scientific capital for the would-be inventor, is sufficiently absurd.

—*Graphics or the Art of Calculation by Drawing Lines Applied Especially to Mechanical Engineering.* By ROBERT H. SMITH, Professor of Engineering, Mason College, Birmingham. London and New York; Longmans, Green & Co., 1889. Price, $5.00.

This work consists of an octavo volume of text having xxi × 257 pages, and a quarto atlas containing 29 plates. It is our experience that it is not usually a good plan to have two volumes of a work so different in size, for often they become separated on the shelves thus causing trouble and vexation of spirit.

The author, thinking "that none of the books on the subject in the English language is well adapted to the needs of the engineering student who wishes to fit himself for the use of the method in business practice" has attempted to supply the deficiency. The book is evidently written with painstaking care and yet, from our point of view, it is poorly adapted to the needs of the engineering student. It is decidedly of a theoretical rather than of a practical nature. There is much said about vectors, rotors and locors, and indeed the author gives a glossary to explain the special terms and symbols used in his book. The atlas contains finely executed drawing showing the graphical analysis of roof trusses, but the discussion of them in the text is couched in language which we have much difficulty in understanding. No statement is given regarding the proper dead, snow or wind load for roofs, nor can we find that any numerical results are obtained from the diagrams, which appear to be regarded as mere "linkages."

The two volumes before us embrace Part I., which is to be followed by Part II., the first being chiefly "analytic" and the second "synthetic." As Part II. is to aim more at the design of structures and machines, it is to be hoped that it will be better adapted to the needs of engineering students. There are several works on graphic statics by American writers which might be of aid to the author in this connection.

TRADE PUBLICATIONS.

—*Railways.*—C. W. Hunt Co., New York. Paper, 7 × 9¾ ins., pp. 16. Illustrated.

Catalogue of the Hunt system of industrial narrow-gage railways for construction works, plantations, factories, coal and ore handling, etc. Steel ties are used, with light rails. A special feature of this system is that the wheel flanges are on the outer side of the rail, a special grooved rail being used on the outer side of a curve. Different kinds of track and cars are illustrated, with steam and electric locomotives, and there is a list of places where these railways are used.

—*Manila Rope.*—C. W. Hunt, New York. Paper, 7x9¾ ins.; pp. 18. Illustrated.

This is a brief treatise on ropes used for the transmission of power and for hoisting. It contains some interesting information respecting rope, with diagrams of splices, knots, etc., and of the horse power of driving ropes at various speeds, together with formulas, tables and other particulars useful in mill engineering. Also a list of persons using the "Stevedore" rope.

—*Coal Handling Machinery.*—C. W. Hunt Co., New York. Paper, 7x9¾ ins.; pp. 16. Illustrated.

General particulars of plant for loading and unloading coal, and of the buckets, carriers, blocks, screens and coal sheds.

—*General Specifications for the Construction and Maintenance of Interlocking Signals and Switches.*—Union Switch & Signal Co., Swissville, Pa. Stiff paper, 7¼ × 4¾ ins.; pp. 22.

This pamphlet gives particulars of the general principles of signaling, with details of the arrangement and location of signals, general specifications of construction and arrangement of the plant, and general instructions governing the use of interlocking signals.

SOCIETY PROCEEDINGS.

The Iron and Steel Institute.

[FROM OUR LONDON CORRESPONDENT.]

After the excitement of last year's trip to America the autumn meeting of the Iron and Steel Institute has fallen rather flat. It is usual to hold the second meeting of the year either in the provinces or abroad, but this year the council has been obliged to stop at home and hold both meetings in London. The truth is that there are so many technical institutions, societies and congresses of a peripatetic kind now-a-days that it is not always easy to get an invitation for any but the most important of them. While speaking on this subject it may be stated that it is a good deal a matter of regret with many on this side that a more leading and representative society than the Iron and Steel Institute should not have been the first to enjoy the hospitality of the United States. The Iron and Steel Institute exercises very little discrimination as to those it admits within the pale of membership; in this matter differing widely from the Institution of Civil Engineers, the Institution of Mechanical Engineers, or the Institution of Naval Architects. The muster roll is therefore somewhat "mixed," and American engineers must not fancy that all the excursionists of last year were representative British engineers or metallurgists.

Nevertheless, the Iron and Steel Institute includes many distinguished men on its roll of membership, and in spite of certain drawbacks does excellent work year by year. At the recent meeting the following is the list of papers read: "On the Constitution of the Royal Ordnance Factories," by William Anderson, D. C. L., F. R. S., director general of ordnance factories; "On the Measuring Instruments Used in the Proof of Guns and Ammunition at the Royal Arsenal, Woolwich," by Captain Holden, of the Royal Artillery, proof officer at Woolwich; "On the Manufacture of Continuous Sheets of Malleable Iron and Steel Direct from Fluid Metal," by Sir Henry Bessemer, F. R. S.; "On Illustrations of Progress of Material for Shipbuilding and Engineering in the Royal Naval Exhibition," by W. H. White, C. B., chief constructor; "On the Forging Press," by W. D. Allen, of Sheffield; "On the Elimination of Sulphur from Pig Iron," by J. Massenez, of Hoerde, Germany; "On an Undescribed Phenomenon in the Fusion of Mild Steel," by F. J. R. Carulla, of Derby.

As a rule, in the autumn meetings the excursions are the chief feature, but London is not a good district for trips of a metallurgical nature, and practically the only excursion made was to the Royal Arsenal at Woolwich, although other places were announced as being open to the members. Accordingly, on Oct. 6, the meeting was held at Woolwich, the president, Sir Frederick Abel, occupying the chair. Here the first two papers on the list were read—there was no discussion—and the rest of the day was devoted to an examination of the arsenal, or, rather a part of it, for it is obvious that one day would be insufficient to inspect all the departments of so vast an establishment as one extending over 2½ acres of ground, nearly all of which is covered by buildings full of plant and machinery. The manufacture of warlike material is a special branch of mechanics and one which it would not

be profitable to enter into here, but we may give a few figures from Dr. Anderson's paper to show how much is wasted by the necessity of maintaining an army and navy.

The ordnance factories are supposed to be worked on commercial principles, "but in some respects," Dr. Anderson says, "the conditions under which they operate are widely at variance with those that prevail among private manufacturers." This is a true thing and in more ways perhaps than the author of the paper intends to convey. There is much that remains to be desired in the conduct of the ordnance factories, Woolwich arsenal especially, and if private factories were not to operate in manner widely at variance with Woolwich arsenal they would speedily be in the bankruptcy court. There is no floating capital, however, in an ordnance factory beyond some £400,000 or so invested in stores, as the money is always supplied with the order; thus if the army, navy, or any of the colonies order a gun they send the money at the same time to pay for it. The higher appointments are in the gift of the War Office, in which, we may add, is the root of nine-tenths of the mismanagement of Woolwich. Salaries for the higher posts amount to ½ per cent of the cost of work, while 50 per cent. is paid in wages. Each department is governed by a superintendent, who is generally a military officer. The capital account of the ordnance factories is £557,945 for buildings and £718,949 for machinery. By far the larger part of the work is done by the piece, but subletting to middlemen is not permitted. The rating is supposed to be in accordance with outside prices. The men get medicinal attendance free, the cost last year being £19,035. The number of hands employed is 17,000 men and boys. The average wage earned by men and boys is 32 shillings per week. Last year the value of the completed work issued amounted to £2,259,126, and the expenditure on all services, complete and incomplete, was £2,259,126; about equally divided between wages and material.

On the second day of the meeting the Institute met in the old quarters in the theatre belonging to the Institution of Civil Engineers, which extends its wide hospitality to so many kindred societies. The remaining papers were disposed of in the course of a short sitting.

Sir Henry Bessemer's contribution, which was taken first, was in many respects the most interesting. The veteran metallurgist appeared in excellent health and spirits and as vigorous as ever. Sir Henry is an immense favorite in the metallurgical and engineering world, as indeed he must necessarily be while there is any gratitude in mankind. It is not so much from these material considerations that Sir Henry is held in affection and esteem as for his amiable character and universal courtesy.

In the paper he read [fully abstracted in ENG. NEWS of Sept. 24—ED.] he gave an account of some experiments he made 45 years ago in the rolling of steel sheets direct from the fluid metal as taken from the cupola. In the course of these experiments—the records of which were duly registered at the time by the taking out of a patent—it was shown that the elaborate processes of casting steel into ingots, reheating or soaking, breaking down, roughing and finishing in rolls, &c., are not necessary, it being sufficient to pour the molten steel on a pair of longitudinal rolls from the ladle, and continuous sheets can thus be produced in any length. The process met with the approval of the meeting generally. There was more than one steel works manager of note who spoke.

Mr. W. H. White's paper on "The Progress of Material for Shipbuilding and Engineering" was exceedingly interesting. He gave some instances of plates shown in the Royal Naval Exhibition at Chelsea. Two specimens were respectively 1¼ in. thick, 42 ft. long and 6¼ ft. wide; and 1¼ in. thick, 31 ft. long and 7½ ft. wide. An interesting exhibit shown by Whitworth is a weldless boiler shell 12 ft. in diameter, 5 ft. wide and ¾ in. thick. If these rings of plating, without weld or rivet, can be made of even larger sizes at a price to bring them within the limits of commercial competition, it will constitute an advance in the practice of boiler construction, even beyond that of the introduction of corrugated or ribbed flues.

In one thing English steel makers are far behind their German competitors, namely, in the production of basic castings. Of course there is reason for this in the plentitude of phosphoric pig in Germany and the difficulty in getting hematite ore. It must be said, however, that German firms can make good basic engine castings of large size—not as good as English acid steel perhaps, but still, good enough—at a price much below that of the English market. Some of the most remarkable examples of big steel ship castings are the spur stems of armor clad ships, a drawing of one of which was shown on the wall. Of old the spur used to be a solid iron forging, most costly and difficult to make. When forged it had to be machined to make the attachments for plating, stringers, breast hooks &c. Even after that the supplemental parts had to be built in. Now the whole stem piece is cast in one with the spur attached and various parts conveniently arranged for attaching to the ship's structure. The armor plate question, to which Mr. White devoted the remainder of his paper, is too complex to enter into here.

Mr. Allen's paper described a forging press which has been in use for some time in the works of Bessemer & Co. at Sheffield. It is chiefly notable from the fact that the distance at which the ram works from the anvil is regulated by the quantity of water admitted to the hydraulic cylinder. In this way work of any required thickness can be produced automatically and without depending upon the skill of the operator. The key to the position is the arrangement of admission valve, which is described in the paper. A steam cylinder is used for lifting the ram.

M. Massenez described briefly a process for eliminating sulphur by manganese which is very valuable in Germany, but which will not be so likely to come into use in America, where the conditions as to ore are entirely different. The mixer described, however, should be useful to the blast furnace manager as a means of equalizing his pig, irrespective of its use for dephosphorization. According to some diagrams shown the mixer is like a converter (without, of course, the blowing apparatus), holding 70 tons or so, but the author recommends a 120 ton size, and it is evident that where equalization is required the larger the size the more even the results.

American Society of Civil Engineers.—The regular meeting was held Nov. 4, with Mr. A. Fteley, Vice-President (and later Mr. Rudolph Hering, Director), in the chair. The first paper presented was one by Mr. George W. Rafter on "The Measures for Restricting the Use and Waste of Water in force in the City of Rochester, N. Y." The paper was practically a supplement to the paper on "The Hydraulics of the Hemlock Lake Conduit of the Rochester, N. Y., Water-Works," which was read by Mr. Rafter at the meeting on Oct. 21. (ENGINEERING NEWS, Oct. 24.) The restrictive measures included a system of gates at different points or stations on the mains, telephonic communication being provided between these stations and a central station to provide for the wider opening of the gates in case of fire. A system of house-to-house inspection was also established, street and lawn sprinkling with city water was prohibited, and horse troughs were taxed. Meters were also applied. The result was said to have been satisfactory, the reduction in consumption allowing the reservoirs to become full.

In the general discussion of the two papers, Mr. John Thomson said he did not think reliable results in gaging the flow could be obtained by attaching the piezometers to the air valves of pipe long in use, but that the piezometer pipes should be inserted into the conduit to a certain uniform depth from the outside. The flow might have been controlled by gates at the Mount Hope reservoir or at a point lower on the hydraulic grade. He also suggested that a complete system of metering the domestic supply would have been better than the house to-house inspection, as it would make each consumer interested in checking any waste on his premises. He presented some information in regard to the successful results obtained at Detroit, Mich., by the use of meters in restricting the wasteful use of water. Mr. J. N. Tubbs wrote that there was some annoyance from the restrictive measures adopted at Rochester, and that the sewage tainted water of the Genesee River was used for street sprinkling. He thought the flow of the conduit in 1876 was substantially 9,000,000 galls. per day, as shown by the records of careful gaging, and was 7,000,000 in 1890, as stated by Mr. Rafter. Mr. E. S. Gould thought the measures adopted were correct.

A paper on "Modern Methods of Quarrying" was then presented by Mr. Wm. L. Saunders, which referred especially to the advantages of the Knox system of holes and blasting for breaking and splitting rock with a minimum amount of damage. A 1¼-in. hole is drilled, and two or more wedge shaped enlargements reamed out. A slow explosive is used, and an air space left between the charge and the tamping to cushion the shock of the explosion. The rock will split in the direction of the enlarged parts of the hole, running true and straight to great distances, sometimes 25 to 30 ft., and sometimes one hole being sufficient for a block weighing 2,000 tons.

The secretary announced the death of Mr. John M. Goodwin. The following candidates were declared elected:

Members.—Lucian A. Taylor, Boston, Mass.; Edmund K. Turner, Marblehead, Mass.

Associate Members.—Martin J. Caples, Cambria, Va.; Wm. C. Cushing, Indianapolis, Ind.; Emmett C. Dunn, Alexandria, Va.; Marmaduke W. Easby, Johnstown, Pa.; James D. Moffett, Radford, Va.; Nathaniel Roberts, Jersey City, N. J.; Archer C. Stites, Kansas City, Mo.; J. M. Willard, Tacoma, Wash.

Engineers' Club of Philadelphia.—Business meeting of Oct. 17, 1891. President Wilfred Lewis in the chair; present 53 members and 4 visitors.

Captain Spencer C. McCorkle presented the following:

Resolved, That the President be requested to appoint a committee of three to propose measures for bringing the subject of landlocked navigation before the Boards of Trade and other commercial bodies of the principal eastern and southern seaboard cities, with the view of preparing a joint memorial for presentation to Congress, urging the importance of the subject and praying that the necessary preliminary steps be taken in that direction.

Captain McCorkle urged the necessity of interesting the various Boards of Trade and other commercial bodies in the project of perfecting the interior lines of water communication along our eastern and southern coasts, and then bringing the matter to the attention of Congress. The resolution, seconded by Mr. Trautwine, was adopted. The Chair subsequently appointed Capt. McCorkle and Messrs. Foster Crowell and Rudolph Hering as the committee.

Hon. B. E. Fernow, Chief of the Forestry Division of the Department of Agriculture, described the tests of timber now being made under the auspices of that department and urged the necessity for them. The material is to be collected under the direction of experts, and all the data are to be carefully noted, so that not only the section from which the specimen is obtained will be known, but also the entire history of each piece tested. The matter was discussed by Mr. E. E. R. Tratman, visitor, and by Mr. T. Carpenter Smith, and a letter from Prof. J. B. Johnson, who is in charge of the work, was read. A number of photographs accompanying the letter, and illustrating the method of experimentation, were presented to the club and accepted with thanks. The following resolution was offered by Mr. Trautwine:

Moved, That the Secretary be requested to address to the Secretary of Agriculture, Washington, D. C., the accompanying letter, expressing the club's appreciation of the importance of the extensive series of timber tests now being carried out by that department:

HON. JEREMIAH RUSK, Secretary of Agriculture, Washington, D. C.:

Dear Sir: At a meeting of the Engineers' Club, of Philadelphia, held this evening, it was ordered that the Secretary be requested to express to you its appreciation of the great importance of the extensive tests of timber recently undertaken by your Department, and the hope that such appropriations may be granted as will enable the work to be carried on upon the grand scale projected and thus insure for it the desired degree of usefulness.

The resolution, seconded by Mr. Carl Hering, was adopted.

Mr. F. H. Lewis presented a paper on "Soft Steel in Bridges," the specification accompanying which was issued with the notice for the meeting. The use of soft steel, on at least an equal footing with wrought iron and medium steel, was advocated, and numerous tests of the material, in support of the position taken by the author, were presented. The subject was discussed by letter by Mr. C. S. Sims, Jr., and Mr. Chas. S. Churchill, and verbally by Messrs. Henry B. Seaman, E. E. Russell Tratman and James Christie. HOWARD MURPHY, Secretary.

Engineers' Club of Cincinnati.—At the September meeting Mr. A. O. Elzner read a paper on "The Engineer and Architect." He called attention to the intimate relations between the professions and the difficulty sometimes to know where to draw the line, and noted that many of the magnificent ancient works of so-called architecture certainly combined in their construction the ability of both the engineer and the architect.

The professions must evidently depend upon each other for assistance in the carrying out of many of the large works of the present time, or else an architect must be an engineer, or an engineer combine the qualifications of the architect. This is illustrated in the fact that the Board of Architects of the World's Fair buildings at Chicago simply design and determine exteriors for the various buildings, while the work of preparing detailed plans, specifications, the necessary calculations and the construction are all in the hands of a separate engineer department. Many of the improvements and much of the economy in the construction of the present day are due to the assistance of each profession to the other. Incidental to the paper was a reference to and general description of the construction of the tall modern buildings of iron or steel framing encased in brick or terra cotta.

Civil Engineers' Club of Cleveland.—At the regular meeting on Oct. 9 Prof. C. H. Benjamin made a report on the recent visit of the club to the works of the Walker Mfg. Co., describing some of the more novel machines and some of the large pieces of work under construction. Mr. John Walker also gave a description of some of the large pieces of work for cable railways, and the construction of their furnace, by which they are enabled to melt more iron per pound of coke than almost any other furnace of the size in the country. Mr. W. P. Rice gave a report of the Club's visit to the Globe Iron Works Co.'s shops and shipyards. The paper of the evening was by Mr. E. P. Roberts, on "The Incandescent Electric Lamp from the Standpoint of the Electric Light Manager and of the Customer." He exhibited a number of curves showing the life of the lamp when used with different currents, and the relative cost of lamps of different candle power. Prof. C. S. Howe read a short paper on "A New Method of Computing Areas in Land Surveying," by which it is claimed much time can be saved over any of the new methods now in use.

A. H. PORTER, Secretary.

The Southern Society of Civil Engineers held its quarterly meeting in Savannah, Ga., on Oct. 13, President Louis J. Barbot presiding. A paper was read by Mr. M. L. Lynch, of Fort Worth, Tex., on "Railway Location." The next annual meeting will be held in Jacksonville Fla., on Jan. 18, 1892.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Atlanta Society of Civil Engineers.—Nov. 10. Secy., Parker N. Black, Room 39, Capitol Block.
Denver Society of Civil Engineers.—Nov. 10. Secy., Geo. H. Angell.
Northwestern Society of Engineers.—Nov. 10. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.
Civil Engineers' Association of Kansas.—Nov. 11. Secy., J. C. Herring, Wichita, Kan.
New England Railroad Club.—Next meeting, Nov. 11. At United States Hotel, Boston. Secy., F. M. Curtis.
Civil Engineers' Club of Cleveland.—Nov. 13. Secy., A. H. Porter, 50 Euclid Ave.
Engineering Association of the Southwest.—Nov. 13. Secy., O. H. Landreth, Nashville, Tenn.
Northwestern Track and Bridge Association.—Nov. 13. Rooms, Union Station, St. Paul.
American Society of Mechanical Engineers.—Annual meeting in New York; Nov. 16 to 20. Secy., F. R. Hutton, 121 W. 31st St.
Western Railway Club.—Nov. 17. Rooms, Rookery Building, Chicago.
Engineers' Society of Western Pennsylvania.—Nov. 17. Secy., J. H. Harlow, Pittsburg, Pa.
Boston Society of Civil Engineers.—Nov. 18. Secy., S. E. Tinkham, City Hall.
Engineers' Club of St. Louis.—Nov. 18. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.
American Society of Civil Engineers.—Nov. 18. Secy., Francis Collingwood, 127 East 23d St., New York.
Engineers' Club of Cincinnati.—Nov. 19. Secy., J. F. Wilson.
New York Railroad Club.—Nov. 19. Rooms, Gilsey House.
Scandinavian Engineering Society of Chicago.—Nov. 19. Secy., T. G. Pihlfeldt, 113 Adams St.
Montana Society of Civil Engineers.—Nov. 21. Helena.
Western Society of Engineers.—Dec. 1. Secy., J. W. Weston, 230 La Salle St., Chicago.
Engineers' Club of Minneapolis.—Dec. 3. Rooms, Public Library Bldg. Secy., F. W. Cappelen.
Association of Civil Engineers of Dallas.—Dec. 4. Secy., E. K. Smoot, 803 Commerce St.
Technical Society of the Pacific Coast.—Dec. 4. Secy., O. von Geldern, 819 Market St., San Francisco.
Swedish Engineers' Club.—Nov. 7. Secy., P. Valentine, At 231 Union St., Brooklyn, and 616 North 10th St., Philadelphia.
Northwest Railroad Club.—Dec. 5. Rooms, Union Station, St. Paul.
Civil Engineers' Society of St. Paul.—Dec. 7. Secy., C. L. Annan.
Engineers' Club of Kansas City.—Dec. 7. Rooms, Baird Building. Secy., H. Goldmark.

BY an inadvertency corrected elsewhere Mr. DESMOND FITZGERALD, M. Am. Soc. C. E., was credited in our last issue with being the rapid transit commissioner sent to report upon European practice in that direction. The real commissioner was Mr. JOHN E. FITZGERALD, of Exchange Building, Boston. The error originated in mistatements of the local wires, and seems to have been quite general.

PROBABLY no one will deny that there was sound sense in the statement of President JOHN KIRBY at the Master Car Builders' Convention last June that too many of the disputes which arise in the interchange of cars are referred to the Arbitration Committee. Last year 48 cases were referred to them for settlement; and with perhaps a few exceptions, all these might as well have been settled by the parties interested, if they had simply met and considered the matter in an impartial way. As President KIRBY then said, the only guide of the Arbitration Committee is the code of interchange rules, every provision of which is as familiar to each member of the association as it is to the committee.

It does not appear, however, that Mr. KIRBY'S admonition on this point has had much effect; for the report of the last meeting of the Arbitration Committee, just received, shows that 11 disputes were submitted to their decision. In some of these cases, undeniably, a principle was involved in which there was room for difference of opinion, and which demanded an interpretation of the rules to cover the especial case. In most of the disputes, however, a little examination of the question in a fair and unprejudiced manner by the parties interested would result in just as equitable and wise a settlement as the Arbitration Committee can reach, after they have taken pains to investigate the pros and cons of the whole matter.

Undeniably the cost of lawsuits is a great factor in keeping contentious persons from settling their difficulties in the courts. In the Master Car Builders' Association, litigation before the Arbitration Committee, which seems to be growing too popular, would perhaps be reduced to reasonable proportions if the party adjudged at fault had to pay a reasonable sum for the time spent by the committee in deciding the case. It is certainly unfair to ask the time and labor of the committee to be given without compensation, especially where the dispute is one of purely local interest and not one in which a general principle is involved, whose decision would be to the general advantage of the association. The latter class of cases of course may properly be brought before the committee, but it is not this class of cases whose investigation and decision they find burdensome and which is likely to increase beyond all reason in the future if the present rate of growth continues.

A NOTABLE fact which developed by the inquiry into the loss of the U. S. S. *Dispatch* is that her wreck seems to have been the direct result of the mistaking of a white light for a red one. The testimony comes from too many different officers and seamen to make it reasonably possible that the excuse is either an afterthought or due to some individual peculiarity or negligence. If so, the incident illustrates the truth of what we had occasion to suggest in connection with the Grand Central tunnel some months ago, that "a white light seen through smoke and fog looks red," and hence that when lights are dim and smokes and fogs are no unusual incidents, there can never be any certainty that confusion of color may not occur. In railway signaling mistaking a white light for a red one may do no harm, but mistaking a red light for a partially obscured white one does great harm, while in lighthouse practice either mistake is sufficiently serious. The remedy, as respects lighthouses, seems to be to rely very little on red lights, as in themselves sufficiently distinctive, but rather on variations in flashes, or on alternations of red and white. As respects railway signals, the remedy seems to be, (1) to have the signal lights as bright as possible, and (2) where circumstances readily permit or mistakes are especially dangerous to have the lights in duplicate or triplicate. The *Dispatch* incident seems to conclusively show that there is an element of sensible danger in having a fixed white light and fixed red light so near to each other that they may possibly be mistaken for each other, and lends great force to the suggestions of the Engineer Secretary of the Lighthouse Board, chronicled in this issue, that fixed lights should be done away with altogether: that no off-shore lights, but all in-shore lights, should have a red element in them, and that the flashes should be absolutely distinctive for every lighthouse on the coast.

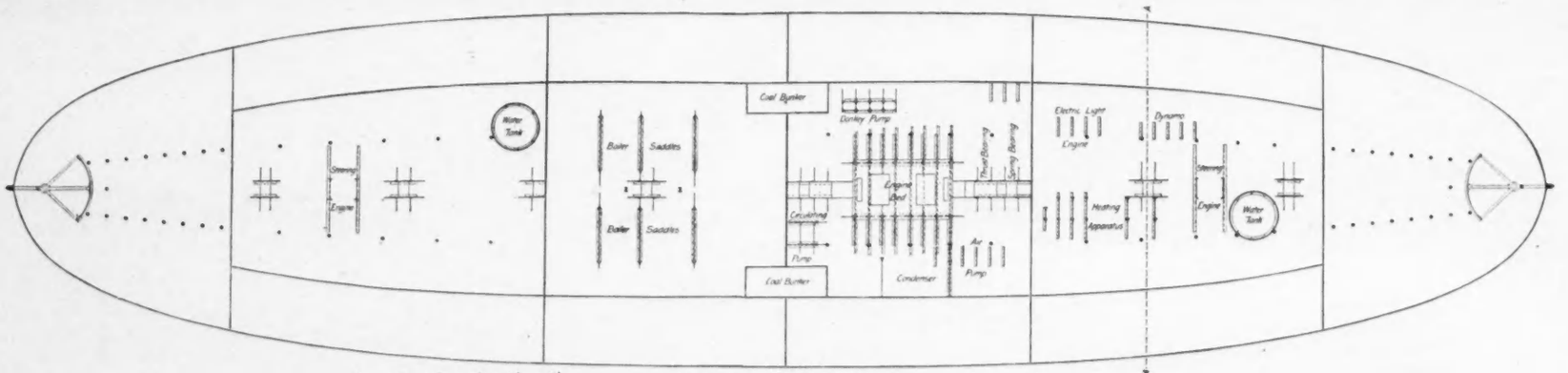
AN article on the "Commercial Future of the Pacific States" in the November *Forum*, advances an argument for the early construction of the Nicaragua Canal which we never saw advanced before, though it would seem to be of enough importance to be more prominently mentioned. It says:

> It is a geographical fact, perhaps little known, that the shortest route from the ports of China and Japan to the Nicaragua Canal passes within 180 miles of San Francisco, and still nearer to San Diego. Consequently, all steamships in this great trade to the eastern coasts of North and South America will make our Pacific coast cities ports of call for coaling, and for discharging and taking up cargoes. This is a fact of great significance, tending to cheapen freights both eastward and westward.

We are unable to check this statement by the company's published statements of distances, according to which the distance from New York to Hong Kong or Yokohama direct would appear to be from 348 to 463 miles longer than via San Francisco, from which it follows of necessity that the course will lie at a still greater distance from that city. Perhaps the explanation is that the usual eastward course from Yokohama to San Francisco follows the arc of a great circle, bringing it far north to the vicinity of the Aleutian Islands, and making only 4,500 miles, whereas the westward course is nearly straight on a Mercator projection and 4,880 miles long, being thus laid (presumably) to avoid the great "gulf stream" of the Pacific. Be this as it may, the loss of distance in going via California is, in any case, very moderate, and would seem to add another great advantage to those which the Pacific coast states will derive from the canal. Not only will the direct cost of transit from their coast be greatly reduced, but their facilities for transit will be increased by vessels engaged in other trades making it a stopping point. The Pacific States have shown through our Chinese legislation that when they are thoroughly in earnest and have a good case they can carry through any measure they wish for against the unconcerned indifference of the eastern majority, and as the construction of the Nicaragua Canal is almost equally vital to their interest, and they will have no unconcerned indifference to fight against, we shall be greatly surprised if they do not speedily push through some measure for the early construction of the canal under government auspices.

Newspaper Electrical Marvels.

The love of the marvelous which is ingrained in our poor human nature has been well fed in recent years by actual achievements in electricity, itself the greatest marvel of all, since we seem to be as far off as we ever were from comprehending the real nature of the "fluid." It has therefore become a most useful field for the wondermongers of the daily press to work in, since they have but scant sense of responsibility for the truth of their statements, while they have a strong and chronic desire to get a column or two of highly spiced food for the jaded palate of the Sunday reader. If only they can mix in a little truth and a little news with their marvels, so much the better, but the marvels must be had anyway, and there is hardly a week in which new ones, which only need to be true to be highly important, are spread at length before the public.



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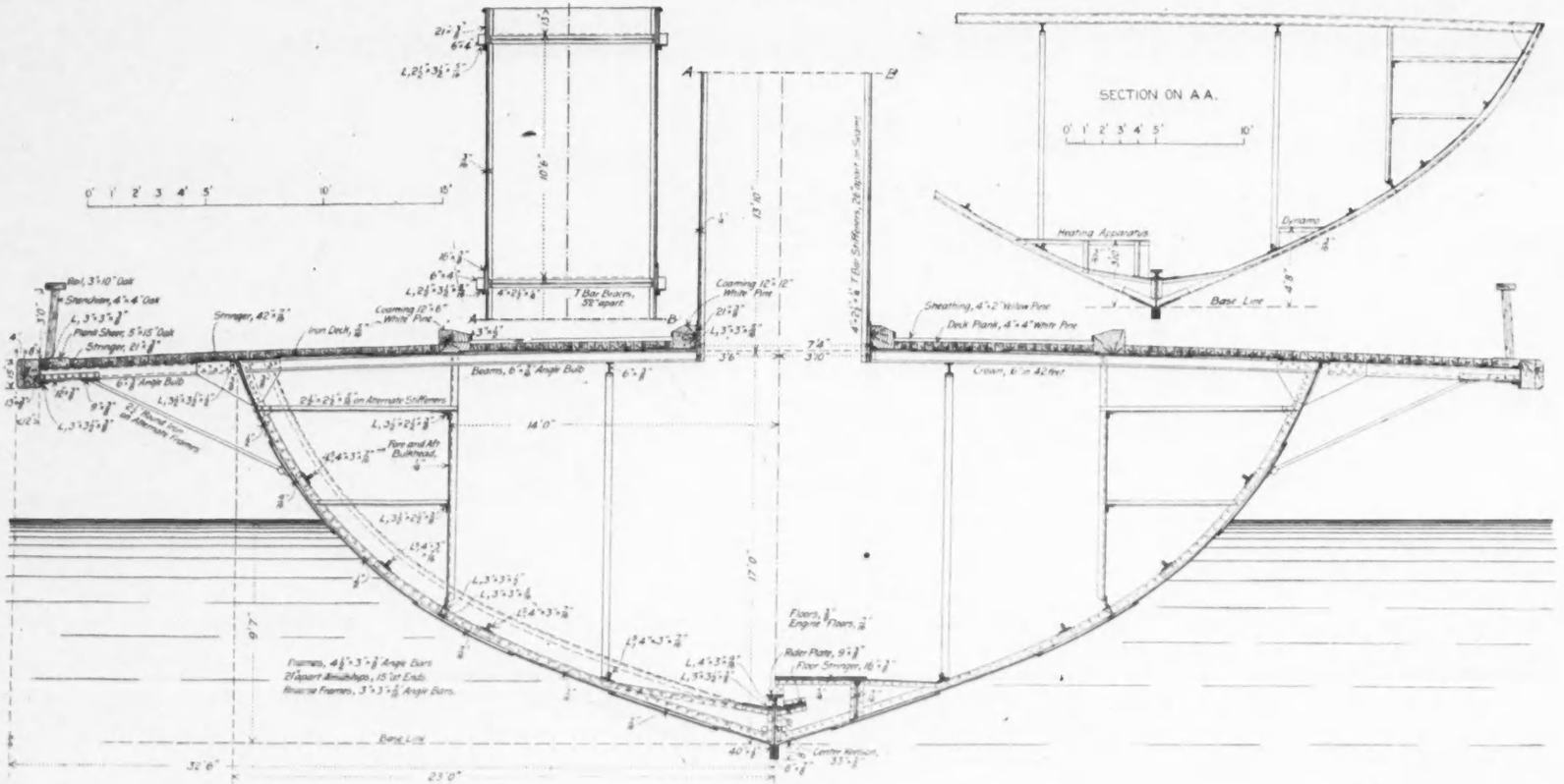

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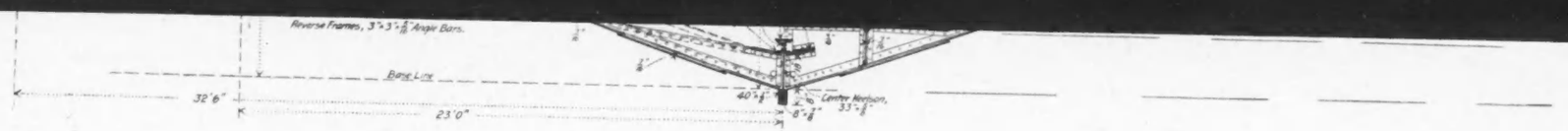

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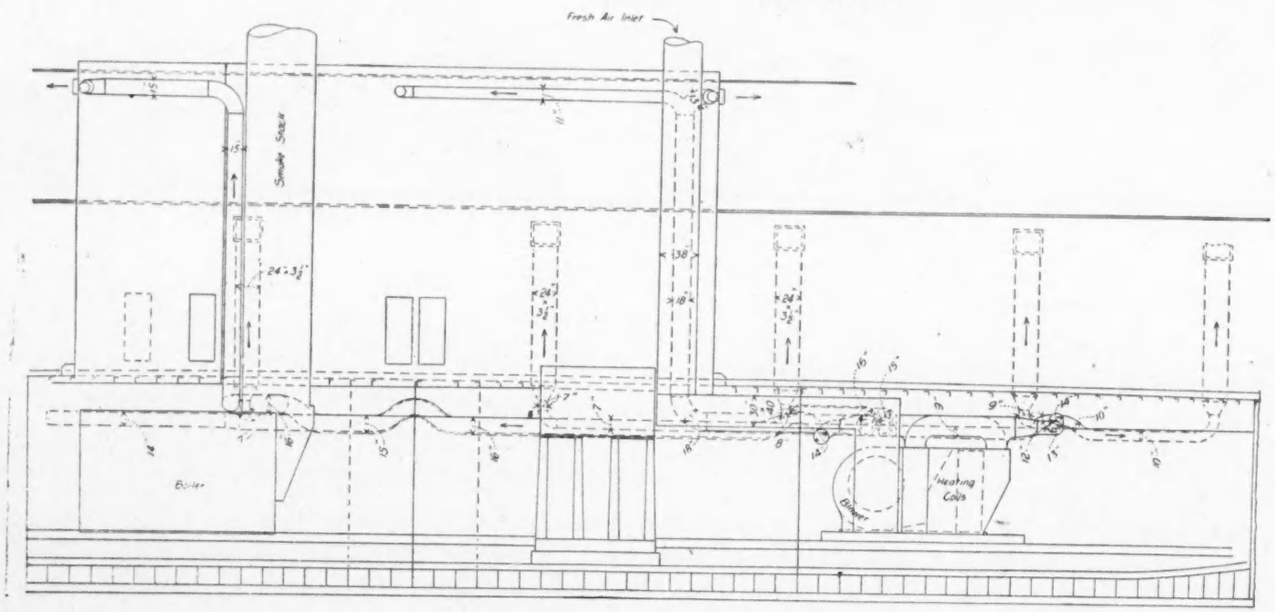

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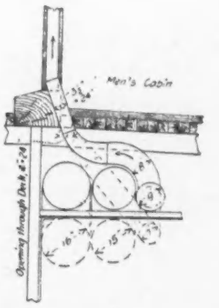

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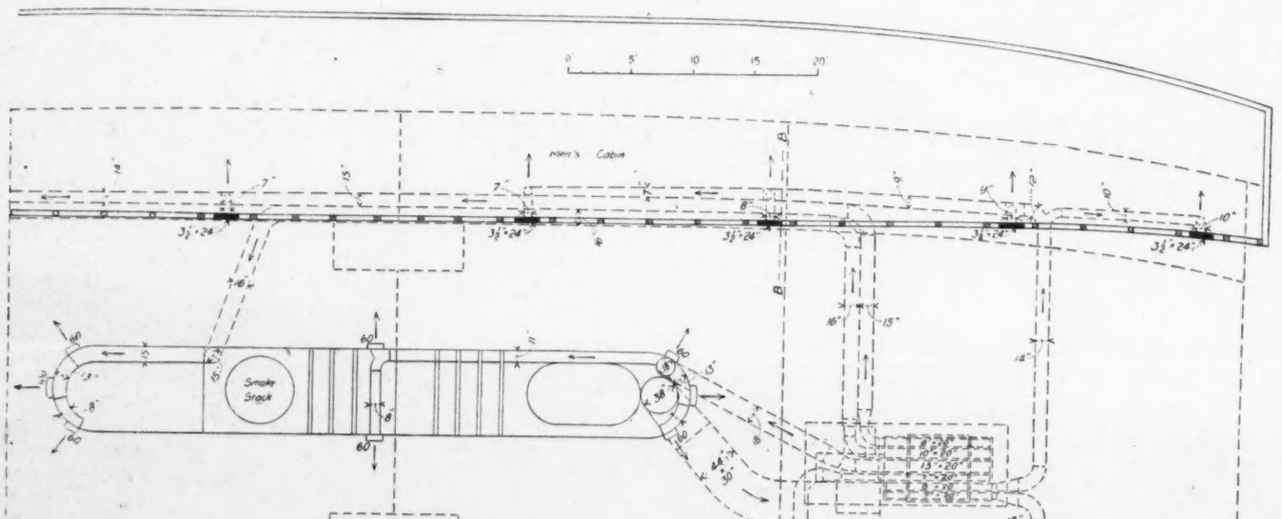
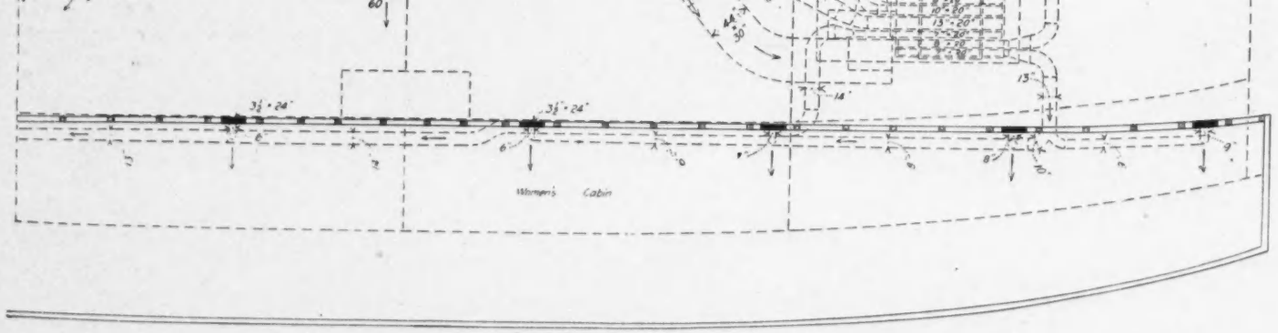




Plan.

ARRANGEMENT OF HEATING AND VENTILATING APPARATUS.

THE DOUBLE-DECK, SCREW FERRY-BOAT CINCINNATI, PENNSYLVANIA RAILROAD.

A couple of columns in last Sunday's New York *Herald* are an apt illustration of this modern tendency to spicy mixtures of truth and falsehood, chiefly falsehood. They are headed, "Exit the Locomotive! 'Tis EDISON who says it," and then what purports to be a literal report of an interview proceeds with some statements so monstrous (intermixed with some others of real interest), that the more intelligent readers of that journal, acquainted with the possibilities of the development of power, have doubtless been expecting to see a denial or correction from Mr. EDISON. That gentleman has been the subject of so many similar articles in the past, however, which he has waited for time to refute, that he may permit this one to go uncontradicted. Very possibly he may never even have seen the reporter's version of what he said.

Be this as it may, what was alleged in the interview as reported was in brief this: An electric locomotive will get a horse power out of one or two pounds of cheap coal, whereas the steam locomotive requires six pounds of dear coal. An electric locomotive can also easily make a speed of 100 miles per hour, while steam can barely make 60. Therefore the electric locomotive will displace steam. It will first do so between Chicago and Milwaukee at the world's fair. Mr. EDISON had run a train at 40 miles per hour 11 years ago over his three-mile track, at Menlo Park, hauling a load of Pennsylvania Railroad officials (which is true), and wanted to run all their trains for them between Jersey City and Pittsburg, but they had not the nerve to adopt his ideas, and he had been waiting for a man who had. He had found him in HENRY VILLARD, who intended to run trains of, say, two cars each every 20 minutes between Chicago and Milwaukee during the exhibition. Whether these trains are to run at 100 miles an hour or not is not distinctly stated, but the implication is that they will. As will be seen from another article in this issue there is plenty of room for improvement in the speeds between these cities. Then Mr. EDISON is alleged to have continued as follows:

"I would not be surprised after that to see Mr. VILLARD introduce the system over the whole of the Northern Pacific lines, though he would not be compelled to introduce it all at once and throw away all his locomotives. By this system electricity can be gradually introduced, more trains being sandwiched in between the steam trains as the locomotive wears out."

"How can that be done and how will the current be applied?"

"I cannot go into details," replied Mr. EDISON, "but I will say briefly that the current will pass from the stationary engine to a central rail between the tracks, thence through the mechanism attached to the bottom of the cars or motor. A freight train, of course, would need a motor because of the number of cars, although a single passenger car could be run carrying its own motor beneath it—thence to the wheels, and thence back by the side rails to the power house or stationary engine."

"And how many of these stationary engines would be needed?"

"Three of them, with a horse power of 10,000 or 12,000 each, would run the whole Pennsylvania Railroad system between here and Philadelphia."

"Freight, local, express trains and all?"

"All of them and at a great reduction of expense. For not only is this horse power produced at much less expense, but the depreciation of rolling stock and roadbed is much less. Every exertion of steam power is in the nature of an explosion, and when you take into consideration the fact that 400 or 500 engines are on a road like the Pennsylvania at one time, each exercising a different degree of this explosive power, the depreciation is a great factor. But with electricity it is always the smooth, rotary motion, imparted in the same way by the same men at the stationary engines."

"Can equipment be devised which will stand the strain of this system at full speed?

The Wizard smiled, "Full speed of this system," he said, "is, or I see no reason why it should not be, 200 miles an hour. But as for practical purposes, I feel sure that a 100-lb. rail on a rock-ballasted track would stand the speed of 100 miles an hour."

"And how will your train be stopped?"

"By air brakes, the same as at present, and that is all the one man who would take the place of engineer and two firemen on the present express trains would have to do, keep a lookout and mind his brake. Indicators would tell the men at the power houses the location of every train at every moment. There, you see, is an absolute block system."

The electric street car problem is then touched upon in part as follows:

As I told you before, any electrician can get high speed. Our trouble was to get low speed to run 4 or 5 mils. an hour when necessary. And some street car grades are 12%. And then the mud. Well, I can pick the current up out of 2 ins. of mud. I have done so on my experimental track down at Orange, but I can tell you it took all kinds of contrivances to do it."

There was another difficulty. The thing was to get a system which a man such as street car lines have to employ could operate without knowing about it. For simplicity's sake I have abolished the central rail. The current passes along one side rail to the motor and back to the stationary engine through the other.

"But in a city street will not conditions arise that will distract the current running along a naked rail under wagon wheels?"

The Wizard smiled again, as if to say, "That's an easy one," and replied: "There are 4 fire engines in the city of New York which have iron wheels, and we'd have to look out for them so mehow. But those are the only vehicles so far as I know, of the thousands in use there which have iron wheels. The rest are all wooden and would not affect the current.

"Now, how about the safety of the public with an electric current running up and down the car tracks in the middle of a crowded street?"

The nearest approach to a proud, triumphant smile which had appeared there, then made its presence known on the Wizard's round, cheerful visage.

"The pressure I use a horse wouldn't feel at all, nor would a man. You see, I employ the heavy current with the low pressure. That is the whole secret of safety. The principle is this, that a stream of water 100 ft. wide which falls a foot gives the same power as a stream 1 ft. wide which falls 100 ft. The wide stream is my way, the high fall some other people's. The whole question is one of expense. A low pressure trolley wire, for instance, requires four times as much copper as a high pressure one.

Mr. EDISON has earned the right to have any statement of his carefully weighed before it is rejected, for he has shown himself to be a real "wizard" in many ways. But there are certain things which not even a "wizard" can ever do, and in the interest of unsuspicious persons who may be duped by some of the extravagances which the *Herald's* reporter puts into Mr. EDISON'S mouth it may be judicious to expose two or three such things in the claims above abstracted.

Mr. EDISON is represented to have said that his system would enable three engines of 10,000 or 12,000 HP. to do the work of the hundreds of locomotives now employed by the Pennsylvania Railroad between Jersey City and Philadelphia. These three engines at the most would be capable of exerting only 36,000 HP., whereas to operate only 100 of the average trains of the Pennsylvania Railroad by the present system requires about 50,000 HP. There are some 400 locomotives employed between Jersey City and Philadelphia. The laws of friction and of gravitation are not going to be altered by any wizard's system, since they were decreed by the Almighty, and the power required to haul a train will be substantially the same under one system as another, let the power of the steam be exerted either through electric motors or locomotives. When allowance is made for leakage and for the losses in conversion and reconversion, it will appear to one of any understanding how absurdly impossible is the proposition to haul not 100 trains only, but three or four times that number. Besides, it may be incidentally remarked that the current representing the capacity of 12,000 HP. would be enough to weld tolerably large bars of iron, yet the reporter says it is intended to return this current through the rails now used and laid upon the ordinary roadbed. The rails might carry it, but how about the joints? We merely suggest this difficulty because it is undoubtedly one which a wizard might successfully grapple with; but neither he nor anyone has yet done so.

A different system is proposed for street railways, namely, the utilization of the rails as electric conductors, divided into sections of moderate length, insulated from each other, the sections of one line of rails being connected to the positive electric conductor and the sections of the opposite line to the negative conductor; the pressure of the current being about 100 volts, which is approximately that used in connection with the downtown lighting stations of the Edison Co.

Now, to propel a modern street railway car requires a maximum of 40,000 watts, which at the pressure mentioned would necessitate 400 ampères of current. To prevent a current of this volume from passing from one rail to the other, except through the motor, the car axles and everything metallic about the car would have to be perfectly insulated; for, if a short circuit were to be, accidentally or otherwise, formed passing through the car body, such a current would set fire to and destroy the car. The effect of such a short circuit was most graphically described by Mr. EDISON himself in an article on "The Dangers of Electric Lighting," which was printed in the *North American Review*, and reads as follows:

Several instances are on record, and one I have particularly in mind, showing the possibility of serious accident through the crossing of wires. Near the corner of William and Wall Sts., New York, the underground conductors of the Edison Illuminating Company became crossed, and the current which was passing through them at a pressure of only 110 volts melted not only the wires but several feet of iron tubing in which they were encased, and reduced the paving stones within a radius of three or four feet to a molten mass.

The volume of current which would be required in operating a street car system as proposed at 100 volts pressure, would be sufficient to instantly melt any ordinary bar of iron which might drop across the two rails, as might easily happen to the runners of a sleigh, for instance; or horses standing across the track would be subjected to serious injury through their shoes by such a current, and be frightened by a much lighter one.

We suggest these little difficulties with some diffidence, as wizard-like achievements in electricity follow fast upon each other, but still it strikes us that those who have been intending to go on with improvements according to the systems of railway operation which have been heretofore in vogue, will hardly find it worth while to delay or postpone them because of such vague talk as the *Herald* reporter puts in Mr. EDISON'S mouth, or in expectation that anything especially new or important in the direction of general railway propulsion by electricity is about to burst upon the world. It may come. It even seems extremely likely that it will come. But the process of improvement in that direction will probably continue to be regular and slow, as well as, let us hope, sure.

Past and Future Railway Speeds.

We reproduce in another column the substance of an interesting article by Mr. THEODORE VOORHEES, General Superintendent of the New York Central & Hudson River Railroad, on the question of the train speeds of the future. Mr. VOORHEES has earned the right to speak on this subject with some authority. His road has made by far the most remarkable special run on record, 436 miles in 426 minutes running time, or 61.44 miles per hour, and this with a heavy train of 130 tons behind the engine. His road is also now running by much the fastest regular train in the world (50¼ miles per hour including stops, 53 miles per hour excluding them) on the longest single fast run, 440 miles, with only four in termediate stops of three minutes each. This is also the heaviest fast train, weighing 131 to 178 tons behind the tender against some 75 to 88 tons (net) on the English limited trains. Moreover, if common report and semi-official implications be correct, this fast train is by no means put on as a finality, but is merely a "starter" toward a much accelerated service between New York and Chicago.

It is therefore a matter of no small interest to see that Mr. VOORHEES, who has had the best pos-

sible opportunities to know how much difficulty his company has had in accomplishing its recent great achievements, unequivocally declares that still higher speeds are within reach, even going so far as to declare that "with continued improvement in" tracks, alinement, locomotives, block signaling, lightening of fast trains, &c., which is now going on, "it is safe to predict that a speed of 100 miles an hour will be attained within the next generation, and probably within the active life of very many men now engaged in railway work."

By this prediction Mr. VOORHEES probably does not mean, at least he does not say, that 100 miles per hour will be a working schedule speed; it is only the electricians who commit themselves to that; but rather that, instead of the present speeds of 40 to 50 regular and 60 to 70 miles per hour occasional speeds, the latter will rise to 80 or 100, and the regular speeds to 60 or 70. Even this will be a great advance, and it is quite great enough to now consider.

The crucial test by which any prediction of this kind is to be judged is, Will it pay? Is there anything to be gained by it, either directly in rates of fare or indirectly in attracting or creating new traffic which will balance the extra cost? A very brief resumé of the past and present situation suffices to show that there is something to be gained in a considerable acceleration of many of our train speeds, while it does not appear that there is any great sum to be lost. If so, the present marked tendency to acceleration may be expected to continue.

The underlying fact which controls the situation and makes probable a continued tendency to higher speeds is this: High speeds are no longer specially expensive in any direct way, because of greater wear and tear. Time was when they were, but the steel rail, heavy sections, good ballast and improved construction of locomotives have changed all that, to an extent which is much better recognized by experts than it was, but is not yet generally comprehended. Despite the many statements to the contrary which have appeared and do appear in engineering literature, the truth is that under existing conditions on first-class roads the direct wear and tear is little, if any greater, with a fast train than a slow one. The extra expense of very high speed is of much moment only in two items: 1. The necessary decrease in weight and length of trains, and 2. The greater interference with the movement of other trains. The first of these can be met, to the extent which is necessary, in the way Mr. VOORHEES suggests, by reducing the dead weight per passenger of very fast trains, and the second to a very large extent by more perfect organization and signal plant. As for the increased difficulty of keeping trains up to schedule time, that, as we have lately had occasion to say, is largely imaginary, the difficulty of precisely maintaining the schedule being not to make the schedule speeds of the separate trains, but to manage the traffic as a whole with machine-like regularity. The trains drop behind not because they cannot make their time, but because irregularities of any kind from any cause must take the form of detentions, since they are not permitted to take the form of accelerations. If no delays had to be feared but those which affected the individual train, and which would have affected it had it been the only train on the line, there would not be enough delays to send the most captious critic to the newspapers. If trains could be permitted to run a little ahead of time as well as behind time, their *average* time would easily be kept up to the schedule.

The recent marked tendency to higher speeds is by no means confined to the East. Many extremely fast special runs have been made in the West also, as well as some of the important accelerations of schedule. Only last week a remarkable fast run was made from St. Joseph, Mo., to Council Bluffs, Ia., over the Kansas City, St. Joseph & Council Bluffs R. R. The announced purpose of the run was to test the practicability of running a new train to connect from the South with the Union Pacific "overland flyer" at Council Bluffs, and the train made 111 miles in 118 minutes, with three stops. This is the best performance yet made west of Chicago, if we do not err, but many nearly as good, and possibly some better, have been made in recent years.

Very fast time can be made therefore on most of our trunk lines East and West.* The direct cost of such time is not great, and the only remaining question is, What is to be gained?

A fact which has very largely affected the speed schedules of the past is that whether it will pay to establish very fast trains between any two cities depends largely on the length of the run between them, and, to be profitable, the increment of speed must usually be quite considerable. Between many cities, as for instance between New York and Boston, there is but little gain to the passenger from very fast time, and consequently it is not attempted. The trip spoils a whole day or a whole night anyway. Between others, as between New York and Philadelphia, high speed is a great advantage to the passenger, and consequently it is customary. Unless all this be kept in mind it is impossible to compare train speeds fairly, or to duly weigh the pros and cons of very high speeds. The conditions under which high train speeds are most profitable are these:

1. *On short runs.* When it makes it possible to go and return in one day with several hours in the city visited, or to make a round trip in a small fraction of a day.

2. *On long runs.* When it lands the passengers at a more convenient hour, or prevents serious encroachment on another day or night.

The two conditions under which high speeds are not particularly useful are:

1. *On short runs.* When the run is so short that the time consumed is not considerable in any case.

2. *On long runs.* When it saves merely a fraction of a day or night, or causes arrival at inconvenient hours.

An excellent illustration of the truth of these principles as respects long runs is the New York-Chicago run. It is within the memory of every reader when the fastest trains between New York and Chicago made the run in about 36 hours, leaving New York at 6 to 8 P. M. and arriving in Chicago at 6 to 8 A. M. (or even later) the second day following. There was also a corresponding but less important train which made the run in two days and a night instead of two nights and a day.

This was a very slow run, only about 27½ miles per hour, and it was very often quoted abroad as a reproach to us; but what was to be gained by shortening it? To arrive earlier in Chicago would have been worse than useless; a positive inconvenience. To leave later at night would have been of but trifling advantage to the through Chicago passengers, and would have been a decided disadvantage to passengers for intermediate points. To really benefit any one it was necessary to accelerate the speed very much, so as to save a whole night or a whole day, which meant accelerating the speed at one jump about 50 per cent., from 27 miles per hour to 40 miles per hour.

At last this was done, when the limited trains were established, about four years ago, the trains which leave New York at 10 A. M. or 6 P. M. arriving in Chicago at the same hour next day. The only real gain to the traveler by so doing is that he is saved one night in the cars, the same sleeping car fare ($5) being retained, though it is for one night instead of two, and an extra fare of $3 being charged in addition. Nevertheless, these trains have been very successful, and the bulk of through travel is carried by them. Though it was predicted when they first began to run that they would not be long continued, there is now not the least probability that they will ever be discontinued. They have proved decidedly profitable, and sensibly increased the total volume of traffic. The present tendency is rather to bring more and more trains up to this schedule.*

To increase this speed by a small amount would be of little value. It would benefit no one appreciably to be able to leave New York at 12 o'clock instead of 10. But to be able to leave New York at 3 P. M. instead of 10 A. M. and still arrive at Chicago at 10 A. M. the next day would have the great advantage of saving an entire business day, the 5 hours thus saved being to a large proportion of travelers worth nearly as much as if the saving were an entire 24 hours. To do this requires a train speed of 51 57 miles per hour average (980 miles in 19 hours), which is only a fraction of a mile faster than the present speed of the "Empire State" train.

If, then, it is found that passengers cheerfully pay an extra fare of $3 to save a night of travel, why should not a large proportion of them be willing to pay $5 more to save a whole business day of travel, making the trip a night one only? We anticipate that a large proportion of the travelers would be glad of the opportunity to do so, and that in addition a very considerable traffic would be created which does not now exist. An active business man could then do as much traveling as he pleased between New York and Chicago, and yet lose no valuable time, while the increasing multitude who want the best at any cost and are willing to pay for it, would gravitate *en masse* to such a train.

We shall therefore look forward with some confidence to seeing a service of this kind established in the near future. On the other hand, we shall not expect to see the New York-Philadelphia service further accelerated. To make this distance of some 90 miles requires

At a speed (in miles per hour) of	30	40	50	60
A total time of.....	3 h.	2 h. 15 m.	1 h. 48 m.	1 h. 30 m.

It was well worth while to effect the saving of an hour or so which has resulted from the accelerations up to 40 and 50 miles per hour, but it would be no great gain to any one to save the 18 minutes more which might be gained by speeding up to 60 miles per hour. Consequently that is not likely to be done for a long time to come. The same is still more true of shorter runs. In England, for example, between Liverpool and Manchester there are 10 expresses each way, making the run of 37 miles in 45 minutes, which is at the rate of 49¼ miles per hour. At 60 miles per hour it would save only 8 minutes more; the game would not be worth the candle.

Similarly, there a great many runs in the United States, like that between Chicago and St. Louis (283 or 299 miles), which, although long, do not warrant a fast service, for the reason that they spoil a day or a night anyway. The fastest train between the cities named, a single day run excepted, makes the run in 10 h. 20 m. at 27 to 28 miles per hour. Faster time could easily be made, but to make it would only convert a comfortable night's run into an uncomfortable one, and so do rather more harm than good. The single fast day run is made between 7:30 A. M. and 4:45 P. M. at 32½ miles per hour. Were this an entirely independent run it would doubtless be accelerated, but to be of public advantage this acceleration should be

*The New York Central, for example, now runs the following trains between New York and Chicago:

	A. M.	A. M.	P. M.	P. M.	P. M.	P. M.
Leave New York....	10:00	10:30	1:30	4:50	6:00	9:15
		P. M.				A. M.
Arrive Chicago.....	9:45	3:55	3:00	4:50	9:00	8:05
Time, h. and m....	24:45	31:25	26:30	25:00	28:00	35:50

Of these trains only the second and last (really intended for local and not through traffic) approximate to the old 36-hour schedule. The others all approximate closely to the 24-hour schedule.

by starting later rather than by arriving earlier, and moreover (in addition to other complicating connections) the run is a part of a longer run from New Orleans which makes 915 miles in 28¼ h. (32.2 miles per hour). This last is a recent considerable acceleration of past speeds, and this, also, if accelerated at all, would be most naturally accelerated by starting later than noon from New Orleans, rather than by arriving earlier into Chicago.

It is therefore not really practicable at present to make any acceleration that will pay between Chicago and St. Louis; and throughout the South and West there are many slow runs of the same kind which cannot well be accelerated until (1) there is a general acceleration of innumerable connections *at both ends* of the run, or (2) until the traffic between any two points becomes so large as to demand independent trains for its special use, like that between New York and Philadelphia. These two causes, rather than inferior roadbeds or (we need hardly say) lack of enterprise, are holding back the train speeds of the West.

There are a few runs in the West, nevertheless, like the Chicago-Milwaukee run (85 miles in 2½ hours, or 34 miles per hour), which seem unreasonably and unnecessarily slow. These will no doubt be considerably accelerated. There ought to be no difficulty in making a run of 85 miles between any two large cities in two hours, or even less. There are also great numbers of 12 to 60-hour runs throughout the country which can be (and are being) accelerated to much advantage. The recent New York Central achievements will powerfully stimulate this tendency. We shall not be surprised if the average acceleration on such runs throughout the country is 5 miles or more per hour by 1893, and it begins to be clear that in this country, and not in England, the fastest trains are to run hereafter. It will be much to our discredit if they do not, for we have by far the most to gain by them. England has but little to gain by faster trains than she has now. Because of our greater distances we have much to gain.

THE NEW YORK & LONG ISLAND TUNNEL CO. had a franchise granted to it by the Long Island City Council on Oct. 20. This franchise has been fought for a long time.

SEWAGE CARRYING STEAMERS are to be built for the city of London, England. The London County Council has advertised for proposals for the construction of one or two twin-screw steamers, with engines and machinery, each vessel to be capable of conveying from the sewage outfalls in the Thames River out to sea 1,000 tons of sewage sludge.

A NEW METHOD OF DISTINGUISHING LIGHTHOUSES to prevent the mistakes which now sometimes occur, as illustrated in the late wreck of the U. S. S. *Dispatch*, is proposed by Capt. F. A. MAHAN, Engineer Secretary of the Lighthouse Board, and is very likely to be adopted. The three primary changes proposed are (1) abandonment of all fixed lights and use of flash lights only, that it may be at once known whether any light seen is that of a lighthouse or not; (2) use of red elements in in-shore lights only, and always in them in some form, that the off-shore and in-shore lights may be instantly distinguishable; (3) the use of absolutely distinctive flashes for all lighthouses which, by the remotest possibility might be mistaken for each other. Of the 61 off-shore lights (not counting light ships) on the Atlantic coast, 38 are now fixed white, 13 have distinctive characteristics and 16 have 5 characteristics between them. Some lights only 30 miles apart may now be mistaken for each other. The report shows that 89 different signals can be obtained from combinations of from 2 to 6 long (8 sec.) and short (2 sec.) flashes, never exceeding the length of 3 long flashes. If 16 new lights are added on the coast to fill up gaps, as recommended, there will be 79 lights in all, thus giving to every off-shore lighthouse on the Atlantic coast individual characteristics. On the Gulf and Pacific coasts these characteristics would be repeated.

CORRESPONDENCE.

The Limit of Curves for Yard Work.

CINCINNATI, O., Oct. 29, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Do you consider it practicable in yards where room is at a premium to use curves as sharp as 100 ft. radius? Of course such a track would be operated by means of a winch. There are coal yards in this city access to which is only possible over a curve of 100 ft. radius and the question arises whether it is practicable to use so sharp a curve for standard gage track. I have used as sharp a curve as 108 ft. radius, of 55° curve, but have hesitated to venture upon this practice. The latter has given no trouble and is operated without the use of a guard rail, cars being propelled by means of a winch. Your opinion will be appreciated. ENGINEER.

[There should be no difficulty whatever in operating a curve of 100 ft. or even 90 ft. or less radius by either a winch or horses or by suitable yard locomotives. The Manhattan Elevated has such curves, and hauls more trains per day over them than go over any other curves in the world, with a few possible exceptions. Wherever a horse car can go freight cars propelled by horses can and do go, which means going over curves of 40 or 50 ft. radius. The curve resistance is greatly increased by using the very low speed which is alone possible with a winch.—ED. ENG. NEWS.]

The Richmond & Danville Bridge Accident.

DANVILLE, Va., Nov. 2, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: An accident occurred here on the Richmond & Danville Railway at 6 A. M. to day. The first river span of the bridge across the Dan River, on the south side, collapsed, precipitating the shifting engine and three freight cars into the river. Two loaded coal cars were in front and a long train of box cars were behind the engine. The two coal cars and one box car went down with the engine. From a hurried inspection I find that the members of the truss all seem to be unbroken on the west side and on the east side the broken members seem to have been broken by the weight of the engine and box car which lean that way.

The accident *appears* to have been caused by the weight of the engine *bending* the truss and dragging the ends from their resting places on the piers. This, however, is only a supposition on my part, as there has been no time yet for an extended examination.

No lives are reported lost, but the engineman had an arm broken. The engine was shifting cars between the yards in North and South Danville, and was going slow at the time of the wreck, which seems to have been caused solely by the weight of the driving wheels. S. H. LEA.

Remarkable Hoisting Record.

WILKES-BARRE, PA., Nov. 2, 1891.

TO THE EDITOR ENGINEERING NEWS:

SIR: Being a subscriber, and believing that your readers will be interested, I advise you that our Nottingham Colliery (Lehigh & Wilkes-Barre Coal Co.) has beaten all previous records in hoisting in October. We have shipped $76,152\frac{15}{100}$ tons in $24\frac{15}{100}$ days, the average hoist per day being 1,318 mine cars.

The depth of hoist was 470 ft., and all coal came from one opening. The engines were fast motion, 22 × 48 ins., conical drums 4 ft. 1 in. long, 7 ft. diameter at small end and 9 ft. at large end.

This record has never been equaled anywhere in the world to the best of my knowledge. Yours,

ELMER H. LAWALL, Superintendent.

Boston Rapid Transit Report—Correction.

BROOKLINE, Mass., Nov. 2, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I cannot understand why the papers persist in crediting me with that rapid transit report. It was made by Mr. JOHN E. FITZGERALD, Exchange Building, Boston, a lawyer, and not by the undersigned.

DESMOND FITZ GERALD,
Rest. Eng. and Supt. W. Div. B. W. W.

[A general reason common to all the press is probably that a report on a highly technical subject like that of the comparative merits of rapid transit systems is assumed as a matter of course to come from a civil engineer, if there be any engineer from whom it might come, and the distinction between FITZGERALD and FITZ GERALD is too fine for general comprehension. So far as we are concerned, we had the additional reason that an engineer specially interested in rapid transit sent us the report as being by our correspondent above. We may now add that there were certain features of the report which seemed to indicate that it came from a lawyer rather than an engineer. Mr. DESMOND FITZ GERALD should now be employed by the public to report on some legal problem, and honors would be easy.—ED. ENG. NEWS.]

Notes and Queries.

W. U. S. asks: Can you or any of the readers of ENGINEERING NEWS furnish me with the modulus of the common or Briggs' system of logarithms to 15 places? I have it to ten places, but it is not sufficient.

The modulus to 25 places is as follows:

.43429 44819 03251 82765 11289 .....

This may be found in the admirable article on logarithms in the Encyclopedia Britannica, or in various other mathematical publications, some carrying it out much further.

Mr. HARRY J. LEWIS writes us to correct an error in his paper on bridge design, published in our issue of Oct. 17. The maximum depths to which foundations have been carried by compressed air is 110 ft. (at the St. Louis bridge) instead of 140 ft., as stated in the paper.

Underground Wires in Washington, D. C.

The report of the Electrical Commission appointed by the President for studying the underground wire situation in Washington D. C., has been submitted. This board is made up of Mr. ANDREW ROSEWATER, Prof. HENRY A. ROWLAND, and Lieut. FRANCIS R. SHUNK, U. S. A. This report as given in the Washington *Star* may be abstracted as follows:

The commission says that the Western Union Telegraph Co. stands alone in its persistent opposition to underground wires in the district. The commission finds that telegraph wires, operating duplex, quadruplex and other devices are successfully operated underground in New York, Chicago, Brooklyn and Philadelphia, and it recommends the application of an axe to the poles as the only way of removing them from the streets and compelling the Western Union to alter its views. The aggregate annual tax paid for 1890, of all the telegraph, electric lighting and telephone companies amounted to only $1,057.50 for the whole District of Columbia.

In discussing the best systems the commission concludes that with reasonable care and with the use of separate or double chambered manholes for distribution, a system of conduits with separate ducts for different potential cables can be regarded as practicable. They discuss the subway problem at length and decide that the only practicable subway, capable of meeting all conditions, is one affording distinct space for pipe and wire service, and located on each side of the streets and as near to the houses as possible. This would require duplicate water, gas and sewer service, but it would obviate all tearing up of the street surface. The estimated cost of such a double subway would be from $150,000 to $200,000 per mile, according to the extent of the service provided for. The commission thinks this outlay would hardly be justified in Washington, as all the sewers, gas and water mains are provided for. It is a serious question, says the commission, whether it is justifiable anywhere, saving perhaps in Broadway, New York, to spend this large sum of money simply to avoid the inconvenience and expense of occasional repairs and renewals. It thinks that the time is coming when the area under the sidewalks must be devoted to public use in all large cities, and permits to use this space should be discontinued, or at least restricted to reasonable and uniform limits.

The conduit duct system, which admits of drawing in and taking out wires and cables is, in the opinion of the board, unquestionably the cheapest and most practicable system thus far developed. The board commends the clay conduit for durability and special applicability to the service in Washington. The board approves of the District owning and controlling the conduits, just as is done with municipal water-works and other public improvements.

In accordance with this plan of public ownership, the commission has prepared plans for conduits for all wires, and has provided for extension. These conduits would have from 4 to 16 ducts, with signaling and alarm stations, as far as practicable, placed at the southeast corner of intersections, for uniformity. The plans and estimates are based upon the use of rectangular, vitrified, glazed clay conduits, which have been successfully tested in the District. These are not as cheap as the creosoted

conduits of Philadelphia and Brooklyn, but when encased in concrete, as provided, they will be permanent, without liability to partial combustion by electric leaking. They will cost less, however, than iron or other material, with a relatively greater capacity of ducts.

These conduits would be laid on 6 ins. of concrete, carefully alined and jointed, and then covered with small stone or gravel concrete. The manholes would be coated inside with cement mortar or concrete, with tight fitting covers, sewer connections, &c. The approximate estimate of cost is given as follows:

219,340 lin. ft., or 41.54 miles, 4-duct conduit	$241,230
50,100 lin. ft., or 9.49 miles, 8-duct conduit	105,210
17,600 lin. ft. or 3.33 miles, 12-duct conduit	52,800
11,600 lin. ft., or 2.20 miles, 16-duct conduit	46,400
	$445,640
298,600 lin. ft., or 56.56 miles, allowing 10% for contingencies and supervision	44,564
	$490,204

Total leng. of ducts, 317.68 miles. Cost, per mile, $1,543.

The board says that: Considering that after construction it will take several years to fill all the ducts, and considering the cost of maintenance and supervision, it thinks that 7 cents per lineal foot per year for each duct used is a reasonable rental for the first few years.

The estimates contemplate manholes on an average of 300 ft. apart. Local conditions will make this a variable factor. The cost of manholes also varies with the size of conduits, ranging from $40 to $140 each. In determining the sizes of the respective lines of conduits the board has taken into consideration the service already provided for by the telephone and electric lighting companies. The five miles of conduits laid by each of these companies during the year 1891 have been subject to stipulations in the permits appended. The board does not regard it unreasonable to require from each of them the free use of one duct in each line of conduit for the public service.

As to electric street railways the commission notes the fact that though only 5 years have elapsed since the first wire was introduced, such roads are operated in over 300 cities in the United States, and with an aggregate of 8,000 miles of track. They are thus a future possibility, and the problem is the same with their overhead wires in cities as with wires for electric lighting. The paying operation for the past three years of an underground system for an electric street railway in Buda-Pesth shows that such a system is practicable, and the latest practice, says the commission, shows that the cable system is even more economical than the overhead system of wires.

The conclusions and recommendations of the Commission are given as follows:

(1) In cities overhead wires are objectionable.

(2) Underground wires are practicable for all kinds of electrical service.

(3) Efficient cables for all kinds of electrical service can be manufactured at reasonable cost. Failures of cables heretofore have been due to inferior material, faulty construction or wrong methods of laying.

(4) Conductors carrying high potential currents may be placed close to telephone or telegraph wires without interference by induction. To prevent accident, it is well to place the high and low potential conductors in different ducts, and also to use separate manholes or compartments of manholes.

(5) It is not advisable to limit the potential currents. With proper precaution currents of the highest potential may safely be used.

(6) Efficient management of electrical matters requires a permanent bureau or department, such as exists in Philadelphia and Chicago.

(7) A single subway in the middle of the street is impracticable.

a. Because of its excessive cost.

b. Because it requires connections under the street to the property lines, and so does not do away with the cutting up and repairing of streets.

Where water, gas and sewer pipes are yet to be laid a double subway might be practicable; that is, a tunnel on each side of the street under the sidewalk. When electric wires alone are to be accommodated a system of conduit ducts and manholes, on the "drawing-in" plan, is preferable:

(8) As regards the ownership of the conduits we believe that the interests of the city are best subserved by public ownership and that the method of having them built by a subway company and renting them to the electric companies would result in great trouble and inconvenience to all concerned.

The commission makes the following summary of recommendations:

(1) We recommend the creation of a permanent electrical bureau to supervise all electrical work in the District and to enforce all regulations relating thereto. Its duties should be: To have charge of the fire alarm and police signal service. To direct and supervise the construction of electrical conduits, the erection of poles and placing of wires and all other appliances for electrical service by the District government and to inspect the electrical appliances belonging to private individuals or corporations under permits or franchises. To make periodical inspections and reports of all electrical appliances in the District.

The bureau should consist of a skilled electrician as chief, with a corps of competent assistants. Sufficient salaries should be paid to secure first-class ability. We would recommend a salary of $4,000 per annum for the chief of the bureau; $2,000 per annum for his principal assistant. Since efficiency will require special local and expert knowledge, both of which will increase with length of service, the personnel of the bureau should be made as permanent as possible; changes should be made for imperative reasons only.

(2) We recommend that within the limits indicated on the plans submitted all wires should be put underground as soon as possible, and that the District Commissioners be empowered to summarily remove poles and wires maintained overhead after due reasonable notice for their removal has been given.

(3) We recommend the rectangular clay circuit, manufactured under the Lynch-Lake patents, believing that it is best suited to the requirements of the District.

(4) The telephone and electric light systems being practically underground already, we submit a plan for a conduit system sufficient to accommodate the telegraph, fire alarm and police signal lines of the city, and a reasonable extension of the telephone and electric light systems. The approximate cost of the system proposed will be $490,000.

(5) We believe that all conduits should be owned by the city, and therefore recommend that hereafter all conduits and subways shall be constructed and maintained by the District government under the direct supervision of the electrical bureau, and that the District government shall, as soon as practicable, acquire the ownership of those already constructed.

(6) A reasonable rental should be charged for the use of conduits by furnchised corporations or individuals. For the conduits above recommended we think that an annual charge of 7 cents per foot per duct would be fair.

(7) Should our recommendation as to the public ownership of conduits not be adopted, and should conduits continue to be constructed by franchised corporations, we would recommend that the franchises of such corporations contain an express provision that one or more ducts on each line be reserved for free public use, in addition to such other compensation as may be thought sufficient for the use of the public ground. We further recommend that this provision be extended to the lines conditionally constructed during the past year, and if possible to all existing lines.

(8) In those parts of the District where, for reasons of local expediency, overhead wires may be deemed admissible by the electrical bureau, we recommend that the poles be erected and owned by the District, and that rent, to be determined by the electrical bureau, shall be charged for their use.

Accompanying the report the board submits a set of rules and regulations governing the construction and use of conduits, poles, wires and all other appliances for electrical service in the District of Columbia.

These require yearly reports from corporations as to number and location of wires, &c., and weekly reports of changes, connections and repairs. Linemen are required to wear numbered badges.

Provision is made for inspections, for the branching of cables and wires at manholes, the prompt removal of dead wires and prompt repair of damaged wires.

Poles, where considered necessary, are to be put in position and maintained at the expense of the District and a rent charged for their use by others. A number of rules are made as precautions against danger from high potential wires.

Wires carrying currents at a potential above 500 volts are to be painted bright red by the person or company owning them wherever visible as a signal of danger, and the lead coverings of such cables in public manholes are also to be so painted.

THE PORT HURON TUNNEL is now complete in every detail, and was officially declared open for all classes of traffic on Oct. 27.

THE LEVEL OF THE LAKE VIEW WATER-WORKS INTAKE TUNNEL AT CHICAGO is to be raised 9 ft., to avoid boring through rock, according to the Chicago *News*.

The Godfrey Driven Well System at Fremont, Neb.

The water supply of Fremont, Neb., is now pumped from a system of fifty 2-in. driven wells, grouped and operated in accordance with a method devised by Mr. C. H. GODFREY, of Godfrey & Meals, water-works contractors, Fremont, Neb. The accompanying illustrations present the main features of the well and connections very plainly.

Fig. 1 is a plan showing the location of the wells and the pumping engines. Fig. 2 shows a longitudinal section through one of the groups of wells, the receiving chamber and the pumping station. Fig. 3 shows the grouping of the wells of one battery and the connection between the well casings and the pipe leading to the receiving chamber. The well chambers are 18 ins. in diameter.

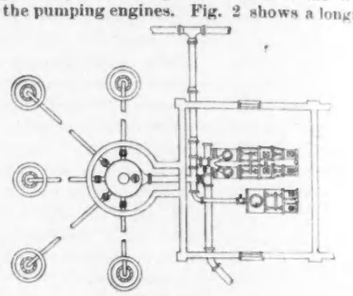


Fig. 1.—Plan.

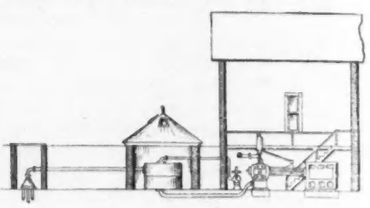


Fig. 2.—Section.

There are five batteries of 10 wells each connected with the receiving chamber by 6-in. suction pipes.

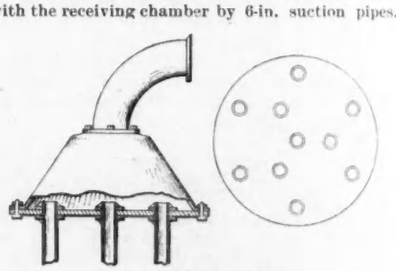


Fig. 3.—Detail of Well.

The chamber is so placed that water will flow from it to the pumps by gravity. Air is exhausted from the central chamber by means of a condenser or independent air pump, so water is delivered to the pumps without the loss by friction incident to direct suction from the pumps through pipes with angles and bends.

The contract provided for a daily supply from the wells of 2,000,000 galls. A 24-hours' test under the direction of Mr. F. H. BURRELL showed a pumpage of 2,400,000 galls., while, according to Mr. BURRELL'S report, no diminution of the water in the wells was shown.

The pumps used in making the test were a 750,000-gall. Deane and a new 1,500,000-gall. Smedley. We are indebted to Mr. GODFREY for the above facts and illustrations.

The Progress of Cable Motive Power for Street Railways.

The following is an abstract of a very lengthy report by Mr. J. C. ROBINSON, presented at the meeting of the American Street Railway Association at Pittsburg. The report commenced with a brief general and historical review.

At first, from the application of cable traction to steep grade lines in San Francisco, Cal., it was thought that the system was only applicable to

straight lines with heavy grades in favorable climates, but this view was changed when cable traction was established in Chicago, Ill., on level lines with sharp and difficult curves, and operated in spite of snow and other atmosphere disadvantages. The first line opened was on Clay St., San Francisco, in September, 1873. It was about 1 m le long, with grades of 16.6%, and rose 300 ft. in its length. The Sutter St. line was opened in 1876, the California St. line, with a grade of 18.5%, in 1878, and the Union St. & Presidio line, with a grade of 19% in 1881. San Francisco has now nearly 100 miles of cable road, and extensions are being built. The annual traffic is about 900,000 passengers per mile, and the average journey 6 miles, with a fare of 5 cts. In 1890 the number of passengers was 70,630,133, or over 200 times the estimated population of the city. The first cable road in Chicago was opened in 1886. Most cable roads have the cable carried in an underground conduit, but Hoboken, N. J., has an elevated cable road 2½ miles long, and Los Angeles, Cal., has some viaduct lines which are for the cable cars only, and have not a conduit (ENGINEERING NEWS, Jan. 25, 1890). The Brooklyn Bridge railway, opened in 1883, is also of this class. In Philadelphia a line with 2½ miles of single track was built in 1883; it had a cast iron conduit, which through faulty design proved a failure, but wrought iron is now being successfully used in New York.

The Tenth Ave. (125th St.) cable road, New York, was completed in 1886 and has 11½ miles. This line was principally constructed on what is known as the Miller system, on designs prepared by the late Col. PAINE. Its specialty lay in the introduction of duplicate cables, the object being to secure constant service during the greater part of the day, one cable being under all circumstances available; and to apply the full power of the system by running alternate cars on the two cables simultaneously when the traffic became crowded. After an interval of 5 years the operation has met with such favor that the complete conversion of the whole of the Third Ave. system is now under weigh, representing an extension of about 12 miles, while the Broadway & Seventh Ave. Co. is not only converting the Broadway line, but extending the system to Lexington Ave. Following up the success achieved in San Francisco, Chicago and New York, the year 1886 marks the period when the cable system began to make rapid progress in the United States, and about 70 roads are now being operated or are in course of construction.

The report then gives the lengths of different companies' lines in various cities, which we summarize as follows:

	Miles.
Kansas City, Mo.	70
Denver, Col.	58
Cincinnati, O.	24
Grand Rapids, Mich.	12
St. Paul, Minn.	15
St. Louis, Mo.	48
Omaha, Neb.	9
Los Angeles, Cal.	20½
San Francisco, Cal.	100
Chicago, Ill.	35
Philadelphia, Pa.	23
Pittsburgh, Pa.	26
Baltimore, Md.	11
Cleveland, O.	20
Washington, D. C.	16
New York, N. Y.	11½
Seattle, Wash.	22
Tacoma, Wash.	3
Oakland, Cal.	10
Sioux City, Ia.	12
St. Joseph, Mo.	6
Butte, Mont.	3
Lincoln, Neb.	5
Hoboken, N. J.	2½
Dallas, Tex.	5
Providence, R. I.	3
San Diego, Cal.	6
Brooklyn, N. Y.	1
Total	577½

Taking the extensions now in process of construction, we arrive at a total of close upon 700 miles of cable road in operation within the United States, besides the lines existing and under construction on the continent of Europe and in the British colonies. A very large proportion of this mileage has been completed in the years 1886-89.

The paper then goes on to refer to the development of cable traction in other countries, which information we condense as follows:

The first appearance of cable tramways outside the United States was in New Zealand, where a firm of engineers—Messrs. Reid & Duncan—projected a line connecting the suburbs of Roslyn with Dunedin, which was opened in 1882. This was the first instance of the use of single track for traffic working both ways on a cable line. It consists of 3,500 ft. of single track, with passing places, and in its course rises 500 ft., the grade being in some places 25%. This proved a great success, and shortly afterward a second line of similar length, but with a double track throughout, was built to connect the suburb of Mornington with Dunedin. The steepest grade on this line is 15%. The first line in Europe was the Highgate Hill road, in London, England, opened May 29, 1884. This is less than a mile long, partly single and partly double track, with steep grades and sharp curves, and is of a different gage from the London horse railways. Edinburgh, Scotland, has two lines on the north side, with grades too steep for horse power. They aggregate about 6 miles of single track, with 1½ miles of double track on each line. The construction is similar to that of the London line. In Birmingham a line about 6 miles long was opened about a year ago (ENGINEERING NEWS, Oct. 24, 1891). The Brixton section of the London Tramways Co. is being cabled, and about 60 miles of different companies' lines in London are scheduled for change to cable power. At Bristol, a 5-mile section will be changed this year. The city of Glasgow, Scotland, which owns the street railway lines and leases them to an operating company, has in view the early conversion of several branches of the system to cable traction, and in the negotiations now being conducted with the Edinburgh corporation for the renewal of the lease of the horse tramways there, conditions are being laid down by the municipality for the cabling of a large section of their more heavily graded lines. The restrictions placed by the government and local authorities upon street railways in Great Britain have retarded the progress of mechanical power. The number of passengers carried is about 13 times the population, and the average speed 7 miles per hour, as compared with 100 times the population and 9 miles per hour in America. In Paris a short line to Belleville was built in 1890, on plans similar to those adopted at London, but with many defects, so that the operation has not been very successful. The question of cabling the part of the southern division of the Paris tramways is under consideration. Melbourne, Australia, has completed a system of cable roads about 85 miles in extent, which is claimed to be not only the largest but probably the most successful in the world, as it certainly is, financially speaking, the most prosperous; while Sydney, New South Wales; Bragga and Lisbon, Portugal; Constantinople and Hongkong have inaugurated, or are in process of adopting the cable.

In regard to construction, Mr. ROBINSON approves of the system now being carried out in New York, with the advantages of duplicate cables, and credits Mr. A. D. WHITTON with the first successful use of iron conduits. Referring to the varying opinions of the respective merits of metal and concrete, he states that a road at Oakland, Cal., was built with a concrete conduit, the track and slot rails being held by rods, and anchor bolts bedded in the concrete. The success of the experiment, in view of possible disintegration, he considers doubtful. On the Pacific Coast, light wrought iron or steel yokes are used, weighing from 150 to 300 lbs., while in the Eastern cities cast iron yokes of 300 to 500 lbs. weight are used. As to the track, general opinion appears to be in favor of grooved steel girder rails and slot rails weighing 40 to 70 lbs. per yard. Provision must be made for the drainage of the conduit. At Los Angeles, Cal., the roads were swamped during heavy rainstorms, and the water flowed through the conduits to the terminal pits and power houses. The following extract is given from a report of the Medical Officer of San Francisco:

The engineer, under whose supervision the roads were constructed, found it necessary for the purpose of drainage to connect the conduit through which the cable runs with the sewers in the street by pipes 4 ins. in diameter; these pipes are placed at intervals of 40 ft., and so thorough does the ventilation seem to be that no complaint has been made of any offensive odors from this sewer since the construction of the line. Speaking from sanitary standpoint, I believe the cable road to be the most desirable thoroughfare to live on, the offensive and mephitic vapors, which under certain conditions of pressure, penetrate the dwellings of other streets in the city, here escape into the open air in a form so diluted as to be both inodorous and innocuous.

The subject of power houses is then considered and the importance of proper location and of the selection of plant of sufficient but not too great power are pointed out. The amount of traffic must be carefully considered, and, with a suitable margin for sudden increase, will guide the engineer in the establishment of a power plant.

The great desideratum is to centralize the power houses so as to command the heaviest strain upon them at about the center of the system, and they should not be placed under street level if that can be avoided. Upon the number and character and extent of the roads to be operated will depend the power necessary to be laid in at any one power house. If the roads are of ordinary grade, conformation and extent, practically any number of cables may radiate from one power house, the length and extent of curvature in the road alone defining the limit within which the cables may be operated. Single cables have been operated to 35,000 and 36,000 ft., and it is known that on a straight level road at Oakland, Cal., a cable of 39,000 ft. has been operated. But it is not considered safe practice to exceed 25,000 ft. in any one cable, particularly where the road presents unusual difficulties in the shape of sharp depressions or sinuosities in the routes. It is found in practice that every right angle curve on a cable road puts a strain upon the cable plant equal to that entailed upon it by 1,000 ft. of straight road.

The expense involved in the operating of a cable road is, so far as regards power, largely independent of traffic, for to run the cable alone a certain expenditure is entailed; therefore, the greater the number of cars propelled the less will be the cost per car mile. It may be assumed that from 40 to 60% of the power used in operating the cable road is consumed in running the dead cable. Mr H. M. KEBBY states that "on 10 miles of road with 30 trains, cable speed averaging 8 miles per hour, the power required to move the cables and machinery was 140 HP., and the average when operating the whole of the loaded trains was 287 HP., leaving in that case about 47% power for cable and machinery." The varieties of cable grips are of two classes, the "side" and "bottom" grip, but for facility of manipulation and general efficiency in the operation of a complicated system of cable roads, I infinitely prefer the "bottom" grip. It is true the "side" grip may be less liable to drop the cable when it is undesirable to do so; but, on the other hand, where quick and positive action is necessary in order to relinquish the cable and regain it at will, the "bottom" grip possesses the advantage. In passing power houses, gravitating over cable crossings, or making terminal switches, all that is required is simply to throw open the "bottom" grip to its full extent, whereupon the cable releases itself, and when the car has traveled over the intervening space by momentum the running cable is recovered automatically. The cable can be instantaneously released and regained without difficulty. At Los Angeles we used a "bottom" grip, 1 lb. of pressure on the lever of which was capable of exerting 300 lbs. pressure on the cable, a reserve power equal to several times the estimated load. The life of the solid steel grip dies was 50 days, 2,506 miles; cost per set of dies, 57 cts.; cost per mile run, .01 ct.; maximum life of cable, 628 days, 100,348 miles. The size of cable most generally adopted is 1¼ ins. diameter; the material should be of the highest grade of crucible steel, and the wires must develop high tensile as well as high torsional strength and possess a good percentage of elongation. If the cable has high tensile strength with a low torsional strength it will soon crystallize and become worthless: if of a high torsional strength with a low or medium tensile strength, it will stretch very rapidly and is apt to strand or break when extra strain is applied. A cable may be run with safety and advantage on city roads, through crowded thoroughfares and round ordinary curves at a speed of 8 miles per hour, while suburban cables running in direct lines to outlying districts may be allowed to attain any speed up to 14 miles per hour. Roads that are short, straight or level, admit, of course, of the longest life to a cable, and, in an economic sense, display the most satisfactory results. On the Temple St. cable road at Los Angeles, coming under the category named, the record showed for a 12,380 ft. cable a period of 38 months in continuous wear, during which time 123,681 miles were run. The Market St. and Geary St. roads, San Francisco, show, respectively, 29 months for 106,225 miles, and 24 months for 119,153 miles run. On the Grand Ave. road, Kansas City, 18,000 ft. of cable gave constant service for 22 months 135,872 miles, the uniform speed being at the rate of 14 miles per hour. In Denver a cable 24,000 ft. in length, running around several right angle curves, made a record of 20 months with 144,000 miles to its credit, while a 22,000 ft. cable operated by the same company attained a record of 19 months with 137,280 miles on a road embracing a 7% grade and four right angle curves. The life of the cables throughout the country displays signs of increase, and at present averages about 14 months, giving from 70,000 to 80,000 miles of service. The introduction of the solid steel or interlocked rope with electric welded splice, has not been attended with any degree of success. After a short trial in Brooklyn, N. Y., this class of cable was found unsuitable for the purpose and was withdrawn from use, and the ordinary cable with hempen core was substituted.

The most important question to be considered in designing winding machinery for cable roads is to propel the rope without injuring it, and with the least loss of power in operating the machinery itself. This, it is considered, is best accomplished by driving both drums and employing as few wraps as possible. On the various lines now in operation differential ring drums, designed to reduce the wear on the cable, are employed with satisfactory results. There are numerous devices for securing a proper tension, and the point the engineer has to consider before adopting any one of them is to see that it is capable of providing against vibration, and the accumulation of slack or sag between the carrying pulleys. If this be not attended to unpleasant surging is the result, and provision should be made in the tension apparatus to obviate this possibility. The permanent stretch of a cable is variously estimated at from 1 to 2%. The cotton rope system of transmission of power from engine to cable drum is employed at several places, and is included in the designs

for the equipment of the power plant in the Broadway road, New York.

The cars are chiefly of three classes, the dummy or grip car, the combination car, and the eight-wheel car. The eight-wheel combination car, with open front finds most favor on the coast, though all the roads in Los Angeles are operated with "dummy" cars, drawing trains of one, two or three trailers, as occasion may demand. It is held by some that the best way to handle heavy traffic in large cities is by single cars and many of them, rather than by the use of trains, but from my experience with both systems I have found the nearest approach to the solution of the problem of passenger transportation in reducing the number of cars by increasing their carrying capacity, and have handled a congested traffic with efficiency by means of the employment of trains. In my opinion, nothing has been more clearly demonstrated than that when regularity and promptness are required, short, light trains of cars are the most likely to clear off a crowd, and at the same time to achieve the most economic results.

In respect to brake power, while in some cases "emergency drags" and "slot anchors" have been provided, ordinarily the track and wheel brakes now universally applied to cable cars, have been found to fill the bill. During some experiments made by me at London, under the inspection of the Board of Trade, in May, 1884, I released a descending train of cars on a grade of 12½%, from the cable, and proceeded by gravitation until the speed indicator attached to the grip car recorded a velocity of 25 miles an hour. I then applied the brakes and stopped the train in 35 ft.

In the practical operation of a road immediate communication at all times with the power house is necessary to the proper maintenance of efficiency. Insulated telegraph wires through the cable conduits for giving between the power house communication to any part of the system by means of a series of signal boxes built within the manholes, and accessible to the employés along the route, seems most worthy of adoption as a ready and reliable signal system.

The average working cost per mile is estimated at at 13 cts., and 60% of the gross receipts represents the average expenditure. In Chicago the cost per car per mile has been 9.65 cts. for cable and 21.985 cts. for horse power. The mileage per car or train averages 110 miles at 9 miles per hour and 18 hours per day.

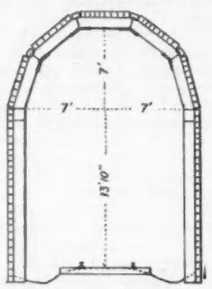
The advantages of cable traction are finally stated as follows: Financially; low operating cost and depreciation, and high earning capacity. Practically; Trustworthiness and independence of climatic conditions. Socially; Facilities for connecting districts with steep grades, and facilities for interchange of traffic. Personally; Agreeable to the public in point of comfort, convenience, accommodation, safety and quietness. Sanitarily; The negative gain of contributing no nuisance, and the positive gain of facilitating drainage.

Cumberland Gap Tunnel.

The following is an abstract of a paper by Mr. J. F. PARR, of Middlesborough, Ky., published in the report of the sixth annual meeting of the Illinois Society of Engineers and Surveyors:

Cumberland Gap, on the state line between Virginia and Kentucky is the chief pass in the range known as the Cumberland Mountains, that extend for about 300 miles in a northeasterly and southwesterly direction. It is some 900 ft. lower than the top of the range, 750 ft. higher than the valley on the Virginia and Tennessee side, and 500 ft. higher than the valley of Yellow Creek on the Kentucky side. Sometime during 1885 or 1886 a company of capitalists began quietly buying all the available property on both sides of the range, consisting of timber, mineral and other lands, and then to look about for a railway toward the different markets and a central point to manufacture the minerals into marketable materials. They decided upon a road to Knoxville, Tenn., known as the Knoxville, Cumberland Gap & Louisville R. R., and prevailed upon the Louisville & Nashville R. R. to extend one of its branches. To build the road and cross the mountain necessitated therefore a separate company, which was organized as the Cumberland Gap Construction Co., with the avowed purpose of constructing a tunnel through the mountain range under the Gap at the most feasible point, and at the same time remain an independent corporation and permit, on payment of a toll, any railway that saw fit to use the same.

Accordingly, engineers were employed and the line located. The alinement on the Tennessee and Virginia side is a 7° curve of 57° to the left from a tangent of 1,900 ft. to within 63 ft. of the east portal; then a tangent of 3,790 ft., passing entirely through the tunnel; then a 6° curve to the left until it passes out of and beyond the west approach on the Kentucky side. The tunnel proper is 3,740 ft. from portal to portal, and cost, including approaches, between $270,000 and $275,000. The grade is 0.4% rise on the Tennessee and Virginia side until about 800 ft. of the tunnel is passed, when it is a vertical curve until a 1% down grade is obtained that continues through the tunnel and west approach on the Kentucky side. The east approach begins in Tennessee and continues for 200 ft., where it enters Virginia and 400 ft. more to the east portal. The tunnel then passes some 800 ft. in Virginia, where it enters Kentucky and continues until the end in Kentucky. The magnetic bearing of the tunnel proper is N. 50° W. Work was begun on the approaches in February, 1888. There were three "lifts" on the east approach and two on the west. In August, 1888, the tunnel was begun. The tunnel was



Section Showing Tunnel Lining.

worked with one heading and one bench from each end at the same time and a day and night shift employed. The work was delayed by a slide within the tunnel after the headings met and before a proper timbering could be placed. The headings met in August, 1889.

The range of mountains through which this great tunnel was bored consists of the following geological formations: Devonian, shales, sandstones, conglomerate, limestone and carboniferous measures, intermingled with laminations of red and brown hematite, clinton, manganese and chrome ores, and clays and coals. The dip of the various veins is at an angle of about 45° with the horizontal plane, the acute angle facing the southeast. Owing to the variety and quality of the materials passed through, there are several that will not support themselves. Where such is the case the tunnel is lined with timber. The upright posts are 10 × 12-in. pieces of oak placed 2 ft. apart, with the depths of the posts at right angles to the tunnel, center to center, and a 6-in. wall behind them and over the arch The arch consists of 5 pieces, 10 × 12 ins. and set on a 12 × 12 in. piece that surmounts the plumb posts. The foot of the plumb posts rests upon the rock at the bottom, except in a few cases, where a block is placed underneath on account of a soft foundation. The clear span of the tunnel is 13 ft. 6 ins. where it is timbered. Where the roof is self-supporting it is made wide enough to timber if it should ever become necessary.

An air compressor was placed conveniently to each end of the tunnel, and all drilling machinery was operated by these compressors, which at the same time forced air into the tunnel. The heading was kept far enough ahead to leave plenty of room between the upper and lower workings to handle all material with ease. The heading material was carried out over the workmen on the bench on temporary trestle or timbers, and deposited or dumped into cars that carried it out of the tunnel. The working from the east approach was delayed somewhat after 500 ft. were passed, by a clayey substance saturated with water that began to slide in and made it quite difficult to timber.

Two coal veins were tapped, one on the west approach and one near the center. These veins are known as "dead" coal, owing to the dip draining them of their oily substance. The grades were such that water did not materially interfere on the west end and not with the east until the summit was passed, when a pipe was placed with a pump at the head to raise it over the grade. This pump was worked by air and was moved forward as the work progressed. The flow of water at the west end is such that an open box 8 × 10 ins. just carries it. At the east end the amount is about half. In the west approach and near the portal an alum water vein was passed through. The side ditches are sufficient to carry away all water.

The method followed to locate the portal of the tunnel was not to begin at a point where it would be a self-supporting roof, but to make an estimate of the cost of each lineal foot until the excavation equaled or exceeded the cost of the tunnel per lin. ft., including timbering. In this case it was found that a depth of cutting of 53 ft. was the limit.

Saranda Tunnel; Bengal & Nagpur Railway, India.

The following particulars respecting this tunnel on the Bengal & Nagpur Railway, a new line which was opened in March, 1891, are taken from an article in *Indian Engineering*. The tunnel is the only one on the line, is 1,583 ft. long, and has a grade of 1%. The ridge which it pierces divides the drainage areas of the Brahmini and Subarnarekha Rivers and connects the Saranda and Lohardagga plateaus. It is somewhat high, and was found impossible to turn. The rock is an indurated slate, having a dip of about 45° north. This has necessitated lining for nearly half the length.

Headings were worked by two intermediate shafts 90 ft. deep, and two shafts about 50 ft. deep at each entrance to the tunnel, so that there was no open face to work at until the deep rock cutting approaches were taken out. The headings were about 8×8 ft., and were first begun as bottom headings and afterward worked into top headings for the purpose of drainage. Six pairs of drillers usually worked on each of the 8×8 ft. headings, each pair drilling two holes 2 ft. deep in an 8-hour shift. The usual charge was ½lb. dynamite, and the progress was 1 to 2½ ft. per 24 hours of three shifts. Much trouble was experienced in preventing the drillers from trying to drill out the holes in which cartridges had misfired, in spite of the many warnings they had by accidents, some of which were fatal. Some of the explosives used proved defective.

Three pumps were constantly at work keeping down the water, which had to be lifted about 110 ft. The east approach runs up to a cutting about 50 ft. deep, and the west approach to a cutting about 60 ft. deep, at the face of the tunnel. The tunnel will be ready for traffic toward the end of the year. Until then the traffic is carried over the ridge by a diversion about 1¼ mile long, with grades of 4.35% and curves of 1,200 ft. radius. The maximum load allowed over this diversion, with the help of a pusher engine, is 10 loaded freight cars.

Clay Puddle.

Puddle is as great an auxiliary to the engineer as concrete, and the best definition that can be given of it is in the following words—a mass of earth reduced to a semi-fluid state by working and chopping it about, while just sufficient water is applied, until the mass is rendered homogeneous and so much condensed that water cannot afterward pass through it. The best puddling stuff is a rather lightish loam with a mixture of coarse sand or very fine gravel in it; the very strong clays are inferior on account of the great quantity of water which they will hold and its disposition to shrink and crack as this escapes; anything in the shape of top-soil is entirely improper on account of the quantity of roots and vegetable matter it contains.

When a puddle ditch has been dug clear out to its proper depth about 9 or 10 ins. in depth of puddling stuff is thrown in, from which all large stones, sticks or weeds are carefully picked out; water is then ladled in with a scoop, so as to give the puddling a good wetting. If the puddling stuff be stiff or dry it may then be left for two or three hours, merely giving it another wetting in the meantime if necessary. The puddler may then proceed with his work. Being provided with a stout pair of puddling boots, he begins at one end of the trench and keeps chopping with his tool, and quite through it, giving his tool a lunging move every time before he withdraws so as to let the water into the puddling stuff and stir it right through; if more water be wanted another laborer supplies it as the puddler works on. This man thus proceeds chopping and trampling over every inch of the ground as he works down the trench until he gets to the end, he then returns and repeats the operation until the stuff is thoroughly worked up. This is ascertained by the tool going with equal ease through every part of the stuff, which it will not do if there are any dry, hard lumps.

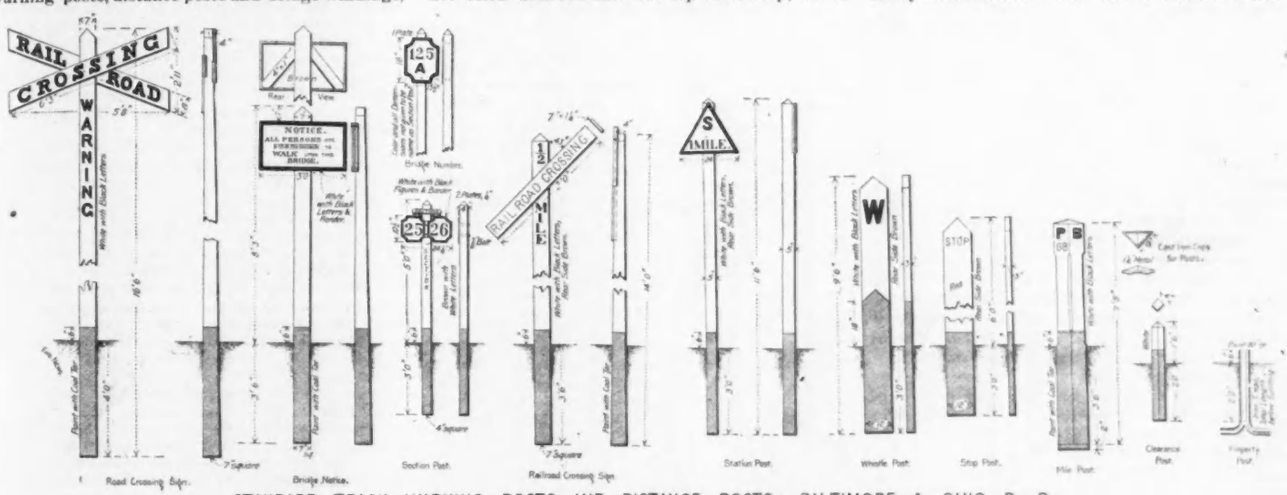
A proper quantity of water is very essential to this work, and it may often have to be brought by means of a trench from some stream or pond at a distance to the works. When this is necessary, care must be taken to provide the means of carrying the water off when it is not wanted. When the first course has acquired some solidity it will be time to lay on the second course, which must not be of greater depth than 10 ins.; water is then applied and the puddling recommences, care being taken that the tool at every chop sinks right down through the upper course into the lower one, so, as it were, to bond them together. A trench thus puddled should never be left uncovered so as to dry. As the puddle is raised, two or three rows of sods or spits should be raised on each side to raise the bank, if the puddle trench be in a bank, and the slopes are formed gradually on each side by fresh stuff being wheeled up until the bank is entirely formed, and then the puddle is covered completely up with ordinary stuff until the bank is raised to its proper height.

When the light loam is not attainable but only clay, mix sand or fine gravel with it if attainable; if only gravel, screen it so as to get rid of all stones larger than a bullet,

mix clay with this if attainable, or chalk where it is to be had. A great part of the difficulty lies in the working of the stuff. The real value of puddle, properly made and well worked, may be ascertained by any one who has had an opportunity of excavating into it years after it has been formed. Having pointed out the great advantages of puddle, it will be desirable to say a few words of its disadvantages. This useful building auxiliary is liable to contract from summer heat if exposed to it, and therefore requires to be protected from this influence, and it will be the more liable to contraction if much water has been used in the working of it and if composed of clay. This is one of the reasons why sandy loam is preferred, and in some cases even fine gravel mixed with chalk, or over which a grouting of rich lime is poured as the puddling process is carried on.—*The Architect.*

Track Standards on the Baltimore & Ohio.

The accompanying drawings illustrate the track warning posts, distance posts and bridge warnings,



STANDARD TRACK WARNING POSTS AND DISTANCE POSTS; BALTIMORE & OHIO R. R.

adopted by the Committee on Standards for use in the Maintenance of Way Department of the Baltimore & Ohio R. R.

The road crossing sign is to be placed facing the approach at all grade crossings of public roads. As no mention is made of any variation from this design, we conclude that the matter is not regulated by law in any of the states through which the Baltimore & Ohio system extends. In some states, however, the design of crossing warnings is governed by statute. In Vermont and Massachusetts, for example, the warning sign must be placed across the highway at such an elevation as not to obstruct travel, and the words "Look out for the engine" must be painted upon it in capital letters at least 12 ins. high.

The "bridge notice" is placed at each end of all bridges not provided with a sidewalk. The object of the sign is doubtless to relieve the railway company from liability for the injury of persons attempting to walk across the bridge, for it is doubtful if any form of bridge notice which could be devised has really any effect in deterring persons walking on the track from crossing the bridge.

The method adopted for numbering bridges is explained as follows:

The bridges are to be numbered so as to indicate the full miles on the division or branch on which they are located and in accordance with the distances given in the time table, and are to be lettered alphabetically to the next mile post. Each division and branch will have its own series of numbers.

Example: Harper's Ferry bridge and Harper's Ferry trestle, both being 72 and a fraction miles from Relay, their numbers will be 72 A and 72 B, First Division. North Branch bridge and the canal bridge, both being 72 and a fraction miles from Martinsburg, their numbers will be 72 A and 72 B, Second Division.

The section posts are placed at the junction points of sections, on the right hand side of the track going from Baltimore, the same as mile posts. These signs may seem unusually large, but they are a convenience for officers who inspect the track while riding over the road.

The distance sign for railway grade crossings is, as it should be, the most prominent of all the signs intended for the guidance of the engineman. It is placed not less than 7 ft. from the rail on the engineman's side of the track, and at a distance of one-half mile from every railway grade crossing.

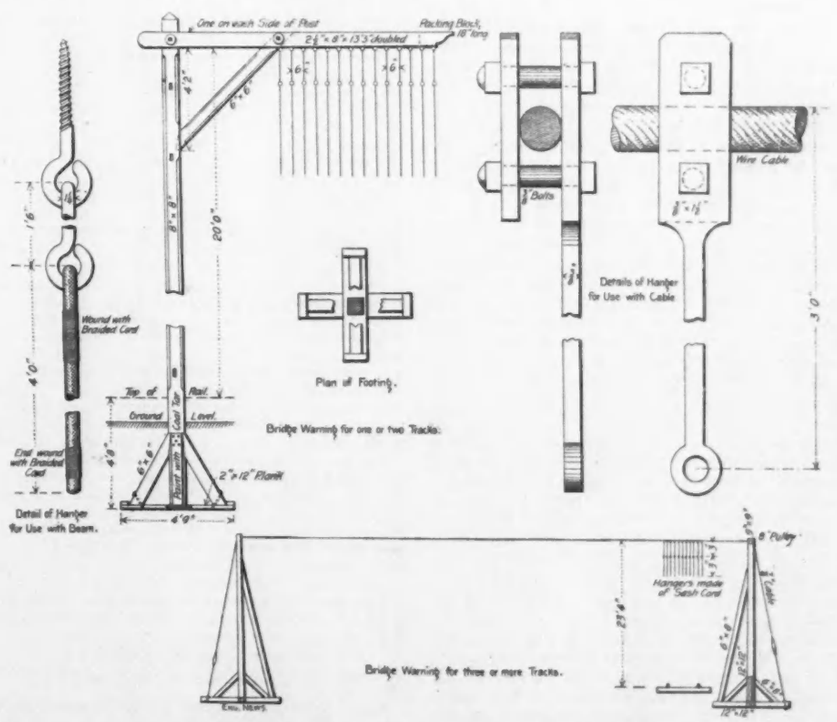
The station sign is also on the engineman's side of the track, and is placed one mile distant from all stations. The whistle post is placed 1,600 ft. from public road crossings and from stations. The stop post is placed at all points where trains must come to a full stop, and is painted red, which ought to make it a pretty effective signal, as the surface exposed is 6 ft. long and a foot broad. The word "stop" is perhaps not as prominent as it might with advantage be, although it is difficult to conceive of an engineman's running past such a prominent red danger signal, even if the word "stop" were not used.

An addition to the mile posts which we believe is not often used is a cast iron cap for the top, which ought to add considerably to the post's durability. The mile posts are placed on the right hand side going from Baltimore.

The clearance post is commendable for its height. Very short clearance posts are apt to be tripped over by yard and train men when working at night. It is questionable whether it is wise to paint it white, a color which might cause a careless engineer to mistake it for a pot signal at safety. A light color is of course desirable to make it readily seen at night, for the reason just stated; but perhaps lemon yellow would be preferable to white, all things considered. These posts are directed to be used at all turnouts and placed between tracks at a point 3½ ft. distant from each rail.

The design for property posts seems a good one, as the post is easily found, and cannot be pulled up or moved except by persons malicious enough to dig it entirely out.

The bridge warning for three or more tracks is of special interest on account of the use of a wire cable instead of an overhead crossbeam to carry the "ticklers." The supporting posts for the cable ought to be set with all possible security, for if a heavy storm should loosen one of them and allow the cable to sag a few feet at the center, trainmen might be swept from the top of the cars by it. The only apparent advantage in using the cable is the saving of expense; but it is questionable whether there would be much saving, if the posts are built with proper security, over the cost of an ordinary


Bridge Warning for one or two Tracks.
Bridge Warning for three or more Tracks.
Plan of Footing.
Details of Hanger for Use with Cable
Detail of Hanger for Use with Beam.
Wire Cable
Hanger's made of Sash Cord

STANDARD BRIDGE WARNINGS; BALTIMORE & OHIO R. R.

crossbeam supported on posts on each side of the track, and for a four track road by an additional post between the center tracks.

For the drawings from which our illustrations are prepared and for the copy of the Rules for the Government of Trackmen which we abstracted last week we are indebted to Mr. WM. A. PRATT, Division Engineer and Chairman of the Committee on Maintenance of Way Standards.

A New Topographical Survey.

BY MR. KENNETH ALLEN, ENGINEER IN CHARGE.

A new topographical survey of the Connellsville coke region is being made by the H. C. Frick Coke Co., covering an area of some 150 sq. miles, about half of which area contains unmined coal, in Westmoreland and Fayette counties, Pa., the work on which has some points of interest and novelty.

The need of having a first-class topographical map of this region has long been felt by Mr. H. C. FRICK, the President of the company, who has always been a strong advocate of good maps. As the holdings of coal lands by his company continued to increase (until at the present time they comprise nearly two-thirds of the whole region), this want was felt more and more. In the absence of any reliable connected map of the region, and after waiting for years for the state to do what it should have done long since, but has not yet undertaken, Mr. FRICK decided to have the work done by his company with such assistance as might be rendered by those most interested.

In the spring of 1890 Mr. FRICK instructed his Chief Engineer, Mr. J. H. PADDOCK, to organize the parties and proceed with this work and to make it as complete as possible. The writer was afterward engaged to take direct charge of the work.

The Connellsville coke region, which has long been noted for its production of a fine quality of coke, comprises a strip of territory extending from Latrobe, on the main line of the Pennsylvania R.R., about 42 miles southwest, to a few miles beyond Uniontown. Lying just west of the Laurel Ridge of the Alleghenies, the region is quite hilly in character, but not mountainous, the surface elevations lying generally between 900 and 1,400 ft. above sea level. While the primary object of the survey was to locate the various coal lands, it was decided to show on the map all streams, roads, buildings, coke ovens, individual farms, 10-ft. contours, coal openings and the coal outcrop on a scale of 600 ft. to an inch.

Surveys were begun early in the summer of 1890. As the company was already in possession of numerous maps and survey notes known to be accurate, it was decided to make use of these in connection with a system of circuits to be surveyed, covering the region, as it were, with a network which would give repeated checks on closing; and some recent checks by meridian observations have shown that a very satisfactory degree of accuracy may be obtained, even on considerable areas, without resort to triangulation. The latter method would have been the natural one to adopt, however, were it not for the fact that many of the lines run would eventually be wanted by the company in any case. The method followed, then, was, first, to establish a network of circuits, following in general the various railway lines and the coal outcrop; secondly, to establish a series of bench marks at convenient intervals over the region; thirdly, to cover the entire area by topographical work, and lastly, to accurately determine all farm boundaries.

The base circuits were completed about March 1. All circuits not closing within 5′ were checked until the error came within this limit. A number of circuits were traversed by calculation, but generally the only check required on the chaining was in the plotting, where the average error found was not far from $\frac{1}{10000}$. A final check on this work was in the determination of the true meridians at five points selected at intervals of about 10 miles from one end of the region to the other. Starting from the most northern point, assumed as correct, the greatest error observed, after correcting for divergence of the true meridians, was 6½′, this error occurring at the most southerly point. As the work was all done with ordinary engineers' transits reading to minutes, this affords a good example of the balancing of errors. The total length of lines thus run and accepted was about 220 miles.

During the spring the bench levels were run, establishing 326 bench marks in addition to others already in use, and the topographical work was commenced. The method pursued in the latter was much the same as that used on the recent surveys for the Philadelphia Water Department under Mr. RUDOLPH HERING, viz., by the use of the stadia with self-reading rod, magnetic needle and field sketching table. The results so far have confirmed the writer in his belief that this method of doing by far the greater part of such work is the best where a fair degree of accuracy is required and economy is of any consideration.

This part of the work is now drawing to a close the mapping being nearly up with the field work Later will come the location and adjusting of the numerous property lines which are not already in the hands of the company.

"One Hundred Miles an Hour."

Mr. THEODORE VOORHEES, Gen. Supt., N. Y. C. & H. R. R. R., contributes to *Frank Leslie's* an interesting article under the above head, containing some practical notes of real value, and expressing a more hopeful view than we should dare to express as to the chances of material further increases of railway speed. The following is an abstract of the more interesting points of the article, on some of which we have commented in another column:

The Mohawk & Hudson River R. R. was opened for general traffic Aug. 9, 1831. This was the first steam railway in America. The Albany *Gazette*, in an article describing the wonders of the new road, said: "Sixty miles in an hour have been run upon the Liverpool & Manchester road and this may be done on the Mohawk & Hudson road."

Sixty years elapsed before the prophecy was fulfilled. For, although a rate of speed equal to 60 miles an hour is to-day no unusual matter, and trains are run daily at that rate on very many different roads, yet this rate of speed is usually confined to short distances. It has remained for the New York Central & Hudson River R. R., the great trunk line of New York, which had its beginning in the Mohawk & Hudson road of 60 years ago, to be the first railway in the world ever to run a train at the rate of 60 miles an hour over its entire length. This was done on Sept. 14 of this year. A special train, weighing in all 230 tons, was run from the Grand Central station to East Buffalo, 436 miles, in 426 minutes, deducting time lost in stops. This was at the rate of 61.44 miles per hour. At Fairport there was an unexpected delay on account of a hot driving-box. Up to that point the distance, 361 miles from New York, had been covered in 360 minutes, including all stops.

During the past decade there have been many well authenticated accounts of high speed for short distances. Under favorable circumstances a speed equivalent to 70, 75 and even 80 miles an hour has been made. The fastest single mile ever run, concerning which a reliable record was kept, was traversed recently by a special train of the Philadelphia & Reading Railroad. This was run in 39¾ seconds, or at the rate of 90 5 miles per hour.

From a consideration of these figures there naturally arises the question: How fast can passenger trains safely travel? The fastest train in America to-day [This was written before the new "Empire State" train began running.—ED.] is the Royal Blue Line between New York and Washington, 226 miles in 5 hours. The actual time of this train from Jersey City to Washington, *including stops*, is 47 miles per hour. On a recent Sunday, being delayed, the train covered the distance, *not including stops*, in 260 minutes, or at a rate of 51.9 miles per hour. The fastest train in England, the "Flying Scotchman," runs from London to Edinburgh, 400 miles, with allowance for stops, in 8½ hours, a rate of 51.6 miles per hour [47.06 miles per hour including stops, excluding 44 min. for stops (a little more than the time table indicates), gives 51.6 miles per hour]. The fastest trains between New York and Chicago are scheduled at an average rate, including stops, of 41½ miles an hour between New York and Buffalo. The through time is 24¾ hours, or equivalent to 39.6 miles per hour. Should a train be run at a speed equal to 60 miles an hour for the entire distance, it would be possible for a passenger to leave the Grand Central Station at 7:40 A. M. and arrive in Chicago at 11:00 P. M., local time, the same day.

Sixty years of American railways and a safe speed attained for passenger trains of 60 miles an hour, while a single mile has been accomplished at the rate of 90 miles an hour. May we not confidently expect that within the first century of American railways passenger trains will be running regularly at a rate of 100 miles an hour?

In a recent article on "English and American Railways,"* by a writer thoroughly acquainted with the systems on both sides of the Atlantic, it was stated: "In the matter of average speed it must be admitted that the ordinary express trains on English railways make better time than the same kind of trains in this country." Also, "In passenger rolling stock equipment American railways are unquestionably very far ahead of English railways." Both statements are true, and both point to the first radical change that must be made in our trains before long-continued high speed can be uniformly accomplished. The English train, designed primarily for high speed and short distances, is light. The actual weight of the "Flying Scotchman" is but 80 tons, in addition to the weight of the locomotive. The average weight of an American "limited" train, exclusive of the locomotive, is three times as great, while the actual number of through passengers per train probably does not vary very much in either case. The dead weight per passenger carried in England is about one ton, while in America it will probably exceed three tons.

The long distances traveled by our limited trains and the demands of the public for luxurious travel have resulted in a greatly increased amount of space and consequent weight being afforded for each passenger. So that while our trains have become marvels of luxury, one convenience after another having been provided as suggested by the ingenuity of our car builders and the demands of competition, a point has been reached where space and weight per passenger must be curtailed or higher speed will be impossible. We must reduce the dead weight of our trains to something approaching the English limits if very high speed is to be accomplished.

In regard to the motive power, it is doubtful if we, on this side of the Atlantic, have anything to learn from the best English practice. On the contrary, recent achievements of American locomotives have probably never been equaled in England. A mile in 39¾ seconds would have been pronounced impossible a few years ago. The English type of engine with a single pair of very large driving wheels, is undoubtedly well designed for high speed with a light train, but a considerable time is lost in starting and stopping, as much as 10 minutes being frequently passed before the maximum speed is attained. On the recent trip over the New York Central road careful records of each mile showed the following: When running at a uniform rate of a mile in 55 or 56 seconds, on approaching a track tank or trough where it was necessary to reduce speed to less than 30 miles an hour in order to take water, the train passed over the mile that included the track tank in 90 seconds and made the following mile in 62 seconds, and by the third mile had resumed the regular rate of 55 or 56 seconds per mile. This while the train load was 130 tons, or 50% more than the "Flying Scotchman." It is doubtful whether a similar performance would be possible with any English engine.

In respect to the permanent way or roadbed, the average railway in this country is confessedly very much inferior to that of Great Britain. The conditions under which the great majority of American railways have been built have necessitated hasty construction, with a view to speedy operation and earnings, and with the expectation of a thorough rebuilding and reconstruction as the lines became established on a firm basis. On the other hand, very many of the principal lines in the country can point to roadbed and bridge secure, permanent and well built, that will compare favorably with the best work abroad. The importance of this matter is being impressed upon railway managers and shareholders more and more day by day. Large sums have already been spent in the straightening and rebuilding of existing lines. Expenditures involving millions are now in progress in different parts of the country.

In respect to highway crossings and the passage of our roads through towns and villages, very much must be accomplished before uniform high speed can be made safe. With the growth of population their number is steadily increasing. There is no doubt that every one is, in some degree, a source of danger both to the trains crossing it and to the traveler on the highway as well. The best known protection for a grade crossing is still attended with very considerable risk to human life. All grade crossings must in time be abolished. As a step in that direction no new crossings, under any circumstances, should be permitted. A suitable law should be enacted, with just provisions for the rights of the public, the neighboring property holders and the railways, which should put this matter under the control and jurisdiction of an impartial tribunal. Then this should be followed by a steady endeavor on the part both of the various cities and towns and the railways to abolish existing grade crossings.

Mr. VOORHEES then urges the importance of more thorough protection of track against trespassers, and continues:

The number of persons killed trespassing on tracks in one year in the State of New York was 313. This slaughter should be stopped, but it only will be when there shall be hearty co-operation between the railways and the state and local authorities. In England upward of 80 per cent. of the railway mileage is protected by the use of what is known as the absolute block system. In this country but very few lines use any block system at all that is worthy the name. Even on some of our most important roads where a block system is in use it is of a form known as the permissive block, which unfortunately is not incom-

*From ENGINEERING NEWS, New York, July 4, 1891.

patible with rear collisions. Of absolute block system there are but a very few miles in use in the United States. Before trains can be run at very high speed, *and at all close together*, it will be necessary to safety to be sure that they are protected by an *absolute* block system. To insure safety with high speed, other points will no doubt suggest themselves to the technical reader, but it is believed that the above are the chief requisites for attaining the end in view.

To recapitulate: We have passed through 60 years of railway life. We have existing railways with permanent way, rolling stock and motive power capable of moving safely and in comfort a paying load of passengers at a uniform rate of 60 miles an hour for any distance from 100 to 1,000 miles. With a continued improvement in roadbed, reduction of curves and grades, abolition of grade crossings, absolute block signals, less dead weight per passenger, and continued increased efficiency in the locomotive, it is safe to predict that a speed of 100 miles an hour will be attained within the next generation, and probably within the active life of very many men now engaged in railway work.

Computing Approximate Areas by Diagram.

We are indebted to Mr. R. C. ST. JOHN, of Princeton, N. J., for the accompanying cuts illustrating an ingenious method of quickly computing many minor areas for sewer computations, &c., which seems worthy of quite extended use for computations of this nature. The idea while extremely simple, is a new one to us. It occurred to MR. ST. JOHN while working on a general system of sewerage, for which it became necessary to compute the acreage of each of the city blocks. This labor, it occurred to him, could be much reduced by using the *equilateral hyperbola* for that purpose in the following manner:

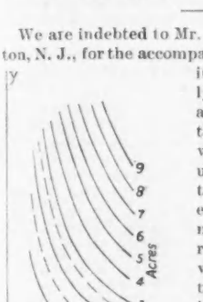


Fig. 1.

Making the constant c, in the equation $xy = c$ (the equation of an *equilateral hyperbola*), equal to the number of square feet in 1, 2, 3, 4, 5, 6, 7, 8 and 9 acres respectively, and plotting with the same scale as the map from which the areas are to be computed each of the resultant curves on a strip of tracing cloth, as in Fig. 1, it will be seen at once that

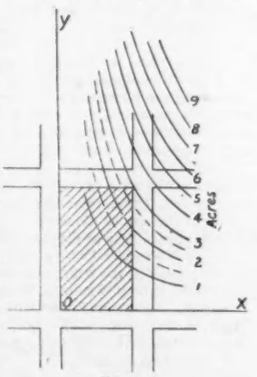


Fig. 2.

by placing this diagram on the map, as in Fig. 2, over the block whose area is required with the axis ox coinciding with one side of the block and the axis oy coinciding with the adjacent side, the corner of the block opposite the origin o will denote by its position the area of the block required. In the same manner the area of any rectangular block may be obtained.

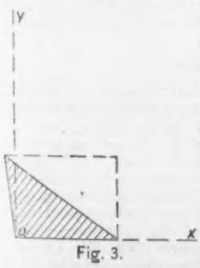


Fig. 3.

If the block is not rectangular it may be divided into triangular parts and the area of each triangle obtained by forming on its base a rectangle, as in Fig. 3, one side of which is the base of the triangle and the adjacent side the altitude. Thus, by obtaining the area of the rectangle and dividing by two, we obtain the area of the triangular part. A moment's thought will show that this can be done without any further marking on the map than one or two short pencil lines through the apices of the triangles formed out of any quadrilateral drawn parallel with the diagonal by which the triangles are formed.

This method may have been adopted before, but as much labor can be saved by its use in working up a general system of sewerage, as well as in other calculations where too great accuracy is not required, and as it will also serve as a check in many cases, it is well worthy of record and remembrance.

THE HUDSON RIVER TUNNEL, work on which is now suspended, has now cost nearly $3,000,000, and what remains undone is estimated to cost $300 per ft. Of the 5,600 ft. under the river, 4,000 is now completed, and 1,600 ft. remains to be driven, besides which there is 4,000 ft. of approach tunnel in Jersey City, and 4,500 ft. in New York yet to be driven. The proposed New York terminus is at Washington Square. Since work was suspended over three months since the air pumps have been kept going in order that the tunnel might be in condition for work when the additional $3,000,000 needed has been raised. This has not yet been done, but the reports are that it soon will be done, and work again resumed.

THE MOST IMPORTANT ARMOR PLATE TESTS since those made a year ago at the Annapolis proving grounds began on Saturday, Oct. 31, at the new proving grounds at Indian Head, on the Potomac, a few miles below Washington. Three plates were tested, one a high carbon nickel steel made by the Bethlehem Iron Co., the second a low carbon nickel-steel made by Carnegie, Phipps & Co., and the third a low carbon steel treated by the Harvey process, made by the Bethlehem Iron Co. Each plate was 10½ ins. thick, 8 ft. high and 6 ft. wide, mounted against an oak backing similar to that used in the tests of last fall (See ENG. NEWS, Oct. 4, 1890). Five shots were fired at each plate, four 6-in. and one 8-in. projectile being used. The 6-in. shots were Holtzer armor-piercing projectiles 17 ins. long, weighing 100 lbs. They were fired with a charge of 42.4 lbs. of brown cocoa powder, and had a muzzle velocity of 2,075 ft. per second. The 8-in. shots were Firminy armor-piercing projectiles, 20 ins. long, weighing 210 lbs. The charge used was 74½ lbs. of brown cocoa powder, and the initial velocity was 1,750 ft. per second. The 6-in. projectiles were fired at each of the four corners of the plates at a point 2 ft. from the side and the same distance from the top or bottom. The 8-in. projectiles were fired at the center of each plate after the 6-in. shots had been fired.

THE RESULTS OF THE TESTS were briefly as follows:

The high carbon nickel-steel plate received the 6-in. shots with an average penetration of about 11½ ins. Each shot except the second caused small radial cracks three or four inches long. Three of the projectiles rebounded. The 8-in. shot at the center penetrated 15½ ins. and cracked the plate diagonally in three directions, one crack extending to the edge, where it opened to 1 in. width. The projectile rebounded.

The low carbon nickel-steel plate received the 6-in. projectiles with an average penetration of 11¾ ins., and with no cracks. Three projectiles stuck in the plate and one rebounded. The 8-in. shot at the center penetrated 20⅛ ins., and stuck in the plate. One through crack was opened extending from the center diagonally through the upper left hand shot hole to the top. It was ¼ in. wide at the edge of the plate.

The low carbon Harvey steel plate received the 6-in. projectiles with an average penetration of 8⅛ ins. In two cases the projectiles rebounded, and in two cases the points stuck in the plate and the butts rebounded. The last three shots caused cracks, one of them 5 ins. deep, but none of them of much width. The 8-in. projectile passed entirely through the plate, the total penetration being 10¼ ins. of plate and 31¾ ins. of oak backing. This cracked the plate diagonally across through its whole thickness, the crack being ¼-in. to 1 in. in thickness. It also cracked the lower edge of the plate quite badly.

Five more plates remain to be tested, including four plates from Carnegie, Phipps & Co., one of high carbon nickel-steel and three plates treated by the Harvey process, one of which is of high carbon nickel-steel, another of low carbon nickel-steel and the third of low carbon steel without nickel. The fifth plate is a high carbon nickel-steel, treated by the Harvey process, and made by the Bethlehem Iron Works. The tests of these plates are to be made very soon.

THE WICKES TUNNEL, on the Montana Central Railway, is to be lined with granite and brick, says a press dispatch, at a cost of about $1,000,000. The Great Northern Railway Co. has made a contract for this purpose with Henry Downes & Son, of Minnesota. The contract covers the 6,000 ft. of the tunnel and 700 ft. of the approaches. The brick arch is to be 20 ins. thick. Work was to have been commenced on Nov. 1, and to be finished in about two years.

OF HIGH BUILDINGS IN CHICAGO, *Harper's Weekly* says the highest building at present (and one which is not built on the new Chicago construction system) is the Auditorium. Its loftiest point is 236 ft. above the sidewalk. The Fair building, now almost completed in one section, measures 241 ft. to the coping, and it is possible that it will be carried higher—to 16 or 18 stories. The new Masonic Temple will measure, over all 274 ft. This is constructed entirely on the new system. The Ashland block measures 210 ft. to the coping; the Woman's Temple, whose topmost stories are now being finished, 266 ft.; the Manhattan, 198 ft.; Monadnock, 194; Henning and Speed block, 192; Abstract building, 190; Chamber of Commerce block, 180; Home Insurance, 178; Tacoma, 175; Northern hotel, 174; Rookery, 164; Owings block, 161; Rand-McNally, 148; Chicago Opera House, 135; and the L. Z. Leiter building, 133 ft.

A SHIP CANAL BETWEEN BRUGES AND HEYST, in Belgium, is proposed, and the government has issued a call for competitive plans. The seaport would be made at Bruges.

SEWAGE DISPOSAL FOR MARSEILLES is an assured fact, says *Le Genie Civil*. This city has been long noted for its unsanitary conditions, and for some years past various plans have been suggested for relief. The plan adopted and actually commenced proposes a large collecting sewer, about 7½ miles long, leading to the sea at Courtiou; and a secondary system of intercepting sewers in the city aggregating about 113 miles in length.

THE CHIGNECTO SHIP RAILWAY TRAFFIC, as estimated, is shown by statements recently issued to be only 7% of the total existing, coasting and sea tonnage of the ports on the Gulf of St. Lawrence, Prince Edward Island and Bay of Fundy. Including both arrivals and departures this latter traffic in the year ending June 30, 1890, amounted to 70,925 vessels and 11,641,769 tons, an average of 154 tons per vessel. Of this traffic about 40% was at Gulf of St. Lawrence ports and 47% at Bay of Fundy ports. The latter traffic is about equally divided between coasting and seagoing; the Gulf traffic is almost wholly coasting. The statements would seem to indicate that there will be a very considerable tonnage to patronize the ship railway when opened.

THE RECLAMATION OF ALKALINE LANDS AT FRESNO, CAL., has been effected by Mr. JOHN S. DORE, in a simple and inexpensive way, according to the Sacramento *Bee*. Mr. DORE had a vineyard of 60 acres planted in 1888. The vineyard was irrigated at the surface as soon as planted, and since then sub-irrigation has been used. The land being spotted with alkali, Mr. DORE selected a spot about an apricot tree which had died, and sent soil from different depths to 3 ft. to Prof. HILGARD, of the State University, for analysis. The analyses showed the samples at the surface to be very heavily impregnated with alkali, while some distance below the amount was said to be merely sufficient to act as a good fertilizer. Mr. DORE thereupon mixed the surface soil with that some 6 or 8 ins. below, and thereafter secured a good growth of vines.

THE MEMPHIS BRIDGE OVER THE MISSISSIPPI, says the *Graphic*, of Hot Springs, Ark., will have a total length of bridge, viaduct and trestle of 8,000 ft. The bridge proper is 2,600 ft. long, the iron viaduct is 2,300 ft. and the timber trestle is 3,100 ft. long. There are 8 piers under the bridge with an eastern abutment. These piers are 117 ft. to 197 ft. high from the cutting edge of the caissons to the pier coping, and the deepest foundation is 131 ft. below high water mark. The central span is 621 ft. long, with cantilever arms 169 ft. long. The anchorage

span is 255 ft. long with a cantilever arm of 169 ft. The truss is 78 ft. high and 30 ft. wide between centers, and the clear hight of the lower chord at center is 75 ft. above high water and 110 ft. above low water. Some of the pins used are 14 ins. in diameter and are 4 ft. 7 ins. long. The bridge is built of steel and proportioned to carry a live load of 4 000 lbs. per lineal foot. A single track of 80-lb. rails will be laid. It is expected that the structure will be finished in April, 1892.

STEEL RAILS IN ENGLAND, says *The Railway News*, of London, for Oct. 24, have reached the lowest point ever quoted. A sale recently took place at Middlesborough, under exceptional circumstances, for £3 11s. 3d. (say $17.33) per ton. But the sale price in South Wales and Monmouthshire at the same time was £4 2s. 6d., or £4 5s. for heavy sections, say $18.60 per ton for the latter. The railmakers look for comfort toward Japan, China and Russia as probable large consumers in the near future. They also say that the "Seventeen year life" according to the average of heavy and lightly worked railways, has nearly expired.

TELEPHONE CONDUITS in Portland, Me., are to be built by the New England Telephone & Telegraph Co. The wires will be laid in a double layer of pipes in concrete laid in a trench. Cables will be drawn into these pipes. The work is in charge of Mr. D. A. HARRINGTON.

THE WORLD'S FAIR BUILDINGS, on which an increased force of 2,000 men is now employed, are already pretty well advanced. The Agricultural building has the floor laid, but no superstructure. The Mining and Electricity buildings have their frames up and will soon be ready for the room. The great Manufactures and Liberal Arts building has the piling and foundations completed and ⅛ mile of floor laid. The great pier, which projects outward from the Casino site to form a harbor, is finished except for some ornamentation, and the sea wall is complete. The Illinois building is being staked out, and the foundations dug for the Administration building. The Fisheries building has three of its walls up. The Woman's building has the main roof nearly finished, and the grand entrances inclosed and ready for ornamentation. The first story of the Horticultural building is now fully inclosed, and ironwork for the great dome is arriving. The roof of the Mines and Mining building is well advanced; 9 of the 10 great cantilever trusses for the central arched roof are in place. The carpentry work of the first story of the Transportation building is approaching completion. Work on the Government building is temporarily stopped, owing to some difficulty with the contractor about the piling.

A VALUATION OF THE WATER AND GAS-WORKS AT DULUTH, MINN., owned by the Duluth Gas & Water Co., has been made for the city by Mr. CHESTER B. DAVIS, C. E., of Chicago. Capitalizing the revenue at 5¼%, the value of the works is given as $1,756,857, exclusive of real estate. The cost of duplicating the works is estimated as $1,628,036, also excluding real estate. In case the city buys the works Mr. DAVIS recommends that the intake be extended into at least 60 ft. of water, that other improvements be made, and that as soon as possible the entire subject of water supply be considered with a view of remodeling the system and providing a high, low and middle service. The city has already voted $800,000 in bonds for city water-works. Recently City Engineer E. H. KEATING estimated the cost of new works, not including the distributing system, at $1,000,000. This included the three services named, with a supply from Lake Superior.

THH COST OF NEW WATER-WORKS AT KANSAS CITY, MO., is estimated by experts M. L. HOLMAN, St. Louis, CHARLES HERMONY, Louisville, and G. H. BENZENBURG, Milwaukee, at $2,425,629. The present works are owned by the National Water-Works Co. Recently the city voted to issue $2,000,000 in bonds for works to be owned by itself, and the above named gentlemen were appointed to report on the proposed works. The experts recommend that water be pumped from the Missouri River to settling basins, from which the low service supply would be drawn by gravity and repumped for high service directly to the mains. The plan includes a river tunnel 6 ft. in diameter and 2,000 ft. long, and a 48-in. conduit 12,900 ft. long. The estimate given above is is for works to supply 200,000 people, nearly double the present population. It is estimated that works to supply the present population could be built for $2,002,435, and that these could be extended as it becomes necessary.

ANOTHER CABLE RAILWAY is to be built in London, England, according to a note in *Industries*. The London Tramways Co., acting upon the advice of its engineer, Mr. W. N. COLAM, M. Inst. C. E., has decided to make a trial of cable traction, and is constructing a line in the south of London, with 5½ miles of cable, extending from Streatham Hill, through Brixton, to Kennington, a portion of which route is at present being worked by horse traction. The new cable system, which is being constructed by Dick, Kerr & Co., of Glasgow, and which is expected to be ready for work in February, is to be on plans modified from American practice and already adopted in Edinburgh. The power station is to be situated at Telford Park, and will be provided with plant sufficiently powerful to enable the company at a future date to extend the system an equal distance outward. It is intended that the cable shall travel at a speed of 8 miles per hour. A novel feature in connection with the installation will be the ready interchangeability of the cars with horse traction, by which means they will be worked from Kennington to the various termini of the company nearer the city.

A STEEL WATER-WORKS INTAKE 8½ ft. in diameter and 2½ miles long is advocated for the Cleveland, O., water-works by Mr. R. POWELL of that city. Mr. POWELL proposes to float the pipe into position and sink it in lengths of 1,000 ft., and to complete the work in four months, without payments on the contract price until the work has been completed and tested. No figures for cost are given, but Mr. POWELL states that the expense would be about 50% as much as a brick lined tunnel.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Cleveland, Wooster & Western.—Work is making good progress upon this railway from Lodi to Wooster, O., 20 miles. Track is now being laid between Burbank and Lodi.

Hoosic Tunnel & Wilmington.—F. W. Sarr, Chief Engineer, writes us that the extension of this railway from Randsboro to Wilmington, Vt., 13 miles, has been completed. Construction began May 20, and the road was opened for business Nov. 4. All but 4 miles of the work was done by the company. It is expected that the extension will develop a large lumber traffic.

Chicago & West Michigan.—Tracklaying is progressing on the extension from Traverse City to Charlevoix, Mich., at the rate of 1 mile per day.——Surveys are reported in progress for a line from Sparta, Mich., to Howard City, Mich., a distance of about 20 miles.

Michigan Central —This company has completed surveys for a line from Caro to Sebewaing, Mich., about 18 miles. There is little prospect of the line being built for some time.

Lake Erie, Essex & Detroit River.—Surveys are in progress for an extension from Leamington to Ridgetown Station, Ont., about 35 miles.

Flint & Pere Marquette.—It is stated that this company is considering the construction of an extension from Port Austin to Grindstone, about 5 miles.

Iron Range & Huron Bay.—Nearly all of the grading has been completed on this line from Huron Bay to Champion, Mich., 60 miles. It is stated that C. D. Miller, of Detroit, has been appointed Chief Engineer in place of Milo Davis, who has resigned.

Grand Rapids & Indiana.—This company is building a branch into the Bear Lake region, Charlevoix Co., Mich., to reach timber lands.

Mahoning Valley.—An extension of this Pennsylvania railway is talked of. The company was chartered to build a railway from the Helvetia mines to Falls Creek, Pa., about 10 miles, and the section from the mines to Stanly, Pa., 2 miles, was completed this season. From Stanly, a series of side tracks was also built, reaching nearly to Falls Creek, but for main line traffic between Stanly and Falls Creek, the tracks of the Buffalo, Rochester & Pittsburg R. R. were used. It is now proposed to extend the main line to Falls Creek, and surveys are being made. W. F. Armes, of Helvetia, Pa., is Chief Engineer.

Sinnemahoning Valley.—Surveys have been completed for the extension from Austin to Galeton, Pa.

Central R. R. of New Jersey.—It is stated that this company has concluded negotiations for right of way for the new line to Long Branch via the north shore of the Neversink Hills. The route will be by boat to Atlantic Highlands, where a railway pier will be built out into Raritan Bay 1,600 ft., thence eastward, along the shore, to the mouth of Shrewsbury River by rail. The river will be crossed by a drawbridge, and the former Long Branch road on Sandy Hook will be reached at Seabright. The real estate for terminals has been bought at Atlantic Highlands, and the bridge structure is ready to be erected. The company has begun grading. The entire line is to be finished by April 1, 1892.

Salem & Washingtonville.—The contract for building this railway from Salem to Washingtonville, O., has been let to Paige, Carey & Co., 15 Broadway, New York City, the work to be finished by Feb. 15, 1892.

Pennsylvania.—Construction is reported in progress on the line from Stanfield Station to a connection with the Dunnings Creek branch in Bedford Co., Pa.——Work is reported in progress on the extension of the Southwest Pennsylvania Ry. south from Fairchance, Pa., to Morgantown, W. Va.——The location of the proposed Roxborough R.R. extension from Philadelphia to the Trenton cut-off has been approved by the Survey Committee of the Philadelphia City Councils.

Bristol.—Tracklaying is making good progress on this line from New Haven to Bristol, Vt., and it is expected that the road will be completed in a few days.

Lehigh Valley.—The City Councils of Allentown, Pa., have passed the ordinance permitting this company to build a belt line about that city.——Work on the Loyalsock extension, which was stopped a few weeks ago, has been resumed.——The Rochester *Post-Express* says:

Notwithstanding reports to the contrary it is probable that the Lehigh Valley will be running trains to this city by Jan. 1. The company has track laid from Buffalo to Caledonia, and the rails have been put down on the bridge at Shortsville, thus completing the line from Geneva to that point. The roadbed is ready for the rails from Shortsville to the Genessee River, and with fair weather the track can be laid from Canandaigua Lake outlet to the river long before Jan. 1. The roadbed is complete on the Honeoye branch to this city from the main line to Mount Hope, and work is progressing rapidly on the mason work for the crossing of the feeder. The abutments for the bridge across the Genessee River are also well advanced and it will be a short job to put the bridge across. The bridge across the Genesse will be the last link required to complete the line.

Cincinnati, Hamilton & Dayton.—This company is considering the construction of a branch to stone quarries in the vicinity of Laurel, Ind., a distance of from 8 to 10 miles.

Philadelphia & Reading.—It is rumored that this company has under consideration the construction of an extension from its main Philadelphia & Atlantic City line to Mays Landing, N. J.——It is reported that the Philadelphia & Seashore R. R. will soon pass into other hands and be extended to Cape May, N. J.

Frost.—A correspondent writes us that grading is progressing at the rate of ¼ mile per day on this railway from Kenton, Mich., to timber lands, 8½ miles. S. Dumond is Superintendent of Construction, and F. A. Palmer is Chief Engineer, both of Kenton, Mich.

Erie & Wyoming Valley.—The people of Honesdale, Pa., are agitating the construction of a branch from that place to the Erie & Wyoming Valley R. R.

Buffalo, Rochester & Pittsburg.—This company has placed an engineering corps under the direction of J. M. Floesch in the field to survey a line from Howard Junction, to Clarion Junction, Pa. The tracks of the New York, Lake Erie & Western R.R. are now used between these points. It is stated that the contract will be let and the road completed as soon as possible.

New York, Lake Erie & Western.—This company contemplates the construction of a branch from Spencerville, O., to East St. Marys, O.

Projects and Surveys.

Chicago, Indianapolis & Chattanooga.—Chartered in Indiana to build a railway from Indianapolis to Rockport, Ind., on the Ohio River. D. P. Irwin, of Indianapolis, Ind., is one of the directors. The projectors intend to build the road to Chattanooga, Tenn.

Reading, Lancaster & Baltimore.—Chartered in Pennsylvania to build a line of railway from Reading, Pa. via New Holland, to a point on the Maryland line in Fulton Township, Lancaster Co., Pa., to connect with a railway to be built from Perryville, Md., with a branch from Strasburg to Lancaster City, Pa., a total distance of 52 miles. President, H. C. Lehanan, Lancaster, Pa.

Castine Ry. & Navigation Co.—It is stated that D. C. Brewer, of New York City, has made a contract to build the railway from Castine to Milo Junction, Me., 81 miles, as soon as the Penobscot Central R. R. Co. subscribes $50,000 and the Castine Ry. & Navigation Co. a like amount. There has now been subscribed about $78,000 of this amount.

Odessa & Middletown.—W. R. Polk, of Odessa, Del., Secretary and General Manager, writes us as follows:

This company was chartered in April, 1873, and the charter was amended Jan. 30, 1889. At the next meeting of the Delaware State Legislature a further amendment

will be asked authorizing an extension of the road. As projected the line will run from Odessa to Middletown, Del., 4¾ miles. This portion of the line has been surveyed and the right of way secured. The proposed extension will be 9 miles long. The route is through a level country affording light work. The contract for construction has been let, the work to be completed by Jan. 10, 1892. William Taylor, of Middletown, Del., is President, and Henry R. Campbell, Room 713, 18 Broadway, New York City, is Chief Engineer.

SOUTHERN.—Existing Roads.

Lynchburg & Durham.—The surveys for the Lynchburg Belt R. R. have been completed and the right of way is now being secured. R. T. Gleaves is the engineer in charge.

Chattanooga Southern.—This company will build spurs to ore mines at Bronco and Dickson, Tenn., and other points. Arrangements are being made to begin work.

Florida Central & Peninsula.—It is expected that work will begin on the spur from Sidney, Fla., south to phosphate mines, within 2 months.

Paducah, Tennessee & Alabama.—Work on the extension from Paris to Hollow Rock, Tenn., is well advanced toward completion. The bridge work is nearly completed and tracklaying will begin soon.

Atlantic Coast Line.—Tracklaying has begun on the Wilson & Fayetteville R. R., at Rowland, N. C. It is intended to lay 10 miles from Rowland, north, and then transfer the force to the Fayetteville end and work south. The grading is completed and it is expected to have the track laid by Jan. 1, 1892.

Central R. R. of Georgia.—An official of the Vankirk Construction Co., now building the Mobile & Gerard R. R. Co., is quoted as saying that the entire line from Troy to Saginaw, Ala., 52 miles, had been graded, and that all but 18 miles of the track had been laid. The line is to be completed by Dec. 1.

Norfolk & Western.—It is stated that construction material is being shipped to the Cripple Creek Extension to the North Carolina line, and that a large force of men will be put at work in a few days.

Roanoke & Southern.—President F. H. Fries is reported as saying that the line from Roanoke to Martinsville, Va., would be completed by Dec. 31. The bridge across Back Creek, south of Roanoke, is now completed and tracklaying will soon be resumed at the northern end. Tracklaying from Martinsville north has reached a point within 11 miles of Rocky Mount. The grading is practically completed, and only a small amount of trestle work remains to be finished.

Georgia Southern & Florida.—A Florida paper states that this company is rumored to have purchased the Tavaros, Orlando & Atlantic R. R., and will extend its line from Palatka to Tavares, Fla., to connect with that road.

Projects and Surveys.

Smithonia, Danielsville & Carnesville.—The money necessary to secure the construction of this Georgia railway has been secured, and it is reported that the contract will be let soon.

Asheville & Weaverville Dummy.—This company has been organized to build a dummy railway from Asheville to Weaverville, N. C. Among the incorporators are D. L. Reynolds and H. B. Carter, both of Asheville, N. C.

Chicago, Henderson, Bowling Green & Chattanooga.—This company and the Evansville & Chattanooga R. R. Co., have been chartered in Kentucky and Tennessee, respectively, to build the proposed railway from Evansville, Ind., to Chatanooga, Tenn., a distance of 255 miles. The officers of the first company are: President, S. K. Sneed, Henderson, Ky.; Secretary, S. L. Marshall, Henderson, Ky.; Chief Engineer, A. B. Fitch, Terre Haute, Ind. The officers of the second company are: President, L. M. Rice, Louisville, Ky.; Vice-President, A. S. Marks, Nashville, Tenn.; Secretary, M. J. Bray, Evansville, Ind.

Georgia, Tennessee & Illinois.—The *Manufacturers' Record* says:

It is asserted that contract has been awarded for building the Georgia, Tennessee & Illinois R. R. projected to extend from Tallapoosa to Stevenson, Ala., a distance of 125 miles. The terms of the contract, it is stated, provide for the commencement of work within 60 days from Oct. 12, and the completion of the road to a junction with the Chattanooga Southern R. R., a distance of 55 miles, within 8 months.

Tuscaloosa Coal, Iron & Land Co.—It is stated that this company has let the contract for building the Tuscaloosa Northern R. R. from Warrior River to coal lands in Tuscaloosa Co., 13 miles. A later dispatch states that the company has been enjoined from letting the above contract.

Florida, Georgia & Carolinas.—W. A. Gaines, President, Mount Carmel, S. C., is quoted as saying that $500,000 have been raised in aid of this enterprise. The road is to run from Asheville, N. C., via Greenville, S. C., Abbeville, S. C., Washington, Ga., and Du Pont, Fla., to Tampa, Fla. It is proposed to build the line from Greenville direct to Asheville, a distance of 65 miles on an air line. From here to Abbeville the track of the Columbia & Greenville road will be used. From Abbeville to Washington, Ga., 40 miles will be built, and from there to Gordon, Ga., another line will be used. From Gordon, Ga., to Du Pont, Fla., the road will have to be built. Twenty miles are now in operation. From Du Pont to Tampa another line will be used. The distance from Asheville to Tampa by the proposed line is about 600 miles.

Arcadia, Gulf Coast & Lakeland.—The locating surveys have been completed for this railway penetrating the Florida phosphate regions. H. B. Harvey, Punta Gorda, Fla., Chief Engineer.

Mobile & Dauphin Island.—T. W. Nicol, of Mobile, Ala., has begun the survey of this proposed railway from Mobile to Dauphin Island.

Oxford & Coast Line.—At a recent meeting of the stockholders of this company the following officers were elected: President, W. F. Beasley; Vice-President, J. G. Hall; Treasurer, H. C. Herndon; Secretary, R. W. Lassiter, Jr. Arrangements are about completed to begin surveys. The line will run from Oxford, N. C., east to Wilson, N. C., 60 miles.

Hinton & New River.—Chartered in West Virginia, to build a railway from the mouth of the Greenbrier River, near Hinton, W. Va., up the river to the mouth of East River in Mercer Co.

Scottsboro & Guntersville.—The Southern Industries Co., 1 Beacon St., Boston, Mass., has secured the charter of this company, and will build its proposed line from Scottsboro to Guntersville, Ala. The line is to be completed by Jan. 1, 1892.

Ducktown Mineral.—The preliminary surveys for this line at Ducktown, Tenn., are completed and estimates are now being made. F. O. Sinclair, Chattanooga, Tenn., Chief Engineer.

Georgia.—Bills incorporating the following companies have been filed with the Secretary of the State of Georgia: Atlanta & Manchester R. R. Co.; from McPherson's Barracks to Manchester; capital stock, $100,000; incorporators, J. H. Mountain, H. L. Woodward and E. B. Woodward, all of Atlanta, Ga.—Tobacco Belt & Florida R. R. Co.; from some point on Savannah, Florida & Western R. R. between Climax and Forceville, Ga., to the Florida line; capital stock, $50,000; incorporators, N. Nicholson, I. W. Lester, B. C. Thomas, D. McGill, G. P. Wood, C. H. Thomas and W. E. Smith.—Transvaal Ry. Co.; from any point in Bibb Co. on east side of the Ocmulgee River to any other point in Bibb Co. on west side of the Ocmulgee River; capital stock, $100,000; incorporators, Geo. B. Turpin, Jos. W. Cabiniss and Aug. A. Bacon, of Macon, Ga.—Jessup & Waynesville R. R. Co.; from Jessup to Waynesville; capital stock, $50,000; incorporators, Philo. D. B. Steinsell and Jos. J. Bell.—Tifton & Northeastern R. R. Co.; from Tifton to Eastman; capital stock, $100,000; incorporators, H. H. Tift, W. A. Tift and E. H. Tift, of Tifton, Ga.—Carrollton & Roanoke R. R. Co.; from Carrollton to Roanoke, Ala.; capital stock, $250,000; incorporators, Geo. E. Hoppe, F. Lanier, Jr., J. H. Barrow and others.—Boston & Albany R. R. Co.; from Albany to Florida line; capital stock, $250,000; incorporators, J. W. Taylor, J. L. Morton, W. M. Brooks and others, of Albany, Ga.—Southern Air Line R. R. Co.; from Atlanta or Newnan to Florida line; capital stock, $5,000,000; incorporators, G. B. Grant, H. W. Hill, J. H. Williams and others.—Atlantic & Northwestern R. R. Co.; from South Carolina line to Alabama line; capital stock, $1,000,000; incorporators, John H. Forney, S. D. G. Brothers, W. H. Smith and others.—Brunswick & Altamaha Canal Co.; canal from Turtle River or Bay, Glynn Co., to Altamaha River; capital stock, $200,000; incorporators, W. E. Burbayo, I. W. Lamb, W. G. Brantley and others, of Brunswick, Ga.

NORTHWEST.—Existing Roads.

Pacific Short Line.—The Sioux City, O'Neill & Western Ry. Co. has been chartered in Nebraska to operate this road. It is stated that an extension from O'Neill, Neb., to Dunning, Neb., will be built next season.

Jacksonville Southeastern.—This company is making surveys for a line from Havana to Rock Island, Ill.

Duluth & Winnipeg.—An official of this road states that it will be extended north to the upper end of Lake Winnebegoshish, a distance of 50 miles, early next season.

Pawnee.—Grading has been begun on the extension of this road to Auburn, Ill., and it is expected to have the line completed within 60 days.

Kickapoo Valley & Northern.—Work is making good progress on this line from Wauzeka to Wilton, Wis. About 8 miles of track have been laid and the tracklaying is now progressing at the rate of ¾ mile per day.

Projects and Surveys.

Bayfield & Great Western.—Surveys are nearly completed for this line from Bayfield, Wis., to a connection with the Northern Pacific R. R. The president of the company is W. F. Dalrymple, Bayfield, Wis.

Phillips & La Crosse.—Chartered in Wisconsin to build a railway from Phillips, Wis., to the Minneapolis St. Paul & Sault Ste. Marie Ry. E. W. Hand is President.

Sioux Falls, Yankton & Norfolk.—E. Bruce, of Yankton, S. Dak., is reported as saying that a charter would soon be asked for authorizing the construction of a railway from Sioux Falls, S. Dak., to Norfolk, Neb.

SOUTHWEST.—Existing Roads.

Pan American.—This company has been chartered in Texas to build the proposed railway from Victoria to Brownsville, Tex., a distance of 240 miles. The new line will include the old Corpus Christi & South American R. R. Co.'s projected line from Corpus Christi to Brownsville, 150 miles. Surveys for the new line have begun at Victoria and it is stated that construction will begin as soon as sufficient of the line has been located.

Georgetown & Granger.—It is stated that grading is nearly completed on this line from Georgetown to Granger, 15 miles. Jas. O'Neill, Ballinger, Tex., Chief Engineer.

San Antonio & Aransas Pass.—Tracklaying has been completed on the extension from West Point to Waco, Tex.

Louisville, New Orleans & Texas.—An effort is being made by the people of Jackson, La., to secure an extension of the Ethel branch of this road to that place. The line would be about 4½ miles long.

St. Louis & Hannibal.—The contract for building the line from New London to Perry, Mo., about 20 miles, has been let to McDonald & Penfield, Fremont, Neb. Work will begin at once.

ROCKY MT. AND PACIFIC.—Existing Roads.

Mason County Central.—Surveys are in progress for an extension of this road to a connection with the Gray's Harbor branch of the Northern Pacific R. R. near Kamalchie, Wash. The extension will be about 10 miles long.

California & Nevada.—This company will soon have in operation a 3-mile extension of its road from Orinda Park to Bryant, Cal. It is intended to extend the line from Bryant to Walnut Creek, 10 miles, next season.

Denver, Lakewood & Golden.—A move is on foot to extend this road from Golden, Colo., west through Colorado and Utah to Salt Lake City, Utah. At present the line is in operation only from Denver to Golden and work is in progress upon a branch to mines. It is not probable that any very long extension will be made for some years.

Projects and Surveys.

Pasadena & Mt. Wilson.—J. W. Sedwick, of Pasadena, Cal., writes us as follows:

There are several projects for a railway up Eaton Cañon, but all are in a state of uncertainty as yet and it will be some time before anything definite is done. The above company made preliminary surveys for its line during February and March of the present year. The line as surveyed is 12 miles long and it will be all mountain work; maximum grade 7½% with reduction for curvature. There will be one trestle 200 ft. long and one tunnel 70 ft. long. All of the right of way has been obtained. T. S. C. Lowe is President and D. J. McPherson is Chief Engineer.

Albany & Astoria.—W. B. Barr, of Albany, Ore., Chief Engineer, writes us as follows:

The preliminary survey has been completed for this proposed railway from Albany, Ore., via Dallas, Sheridan, Dolph and Tillamook, to Astoria, Ore., 173 miles. There will be all classes of work; maximum grade 1½% and maximum curve 10°. There will be 2 tunnels and 2 large bridges. J. L. Cowan, is President.

Stanley, Cascade & Eastern.—R. J. Lawer, of Carson, Nev., writes us that nothing is being done on this line at present, but the company will probably be reorganized and the work pushed ahead.

Salt Lake, Colorado & Gulf.—Chauncy W. Blackman, of Cortez, Colo., Attorney, writes as follows:

This company was formed in April, this year, and the bonds have been issued and a portion of them sold. There is no doubt but that work on the road will begin early this coming spring.

Butte, Anaconda & Pacific.—James McFarlane, of Butte, Mont., Chief Engineer, writes us as follows:

The location is nearly completed for this line. It is projected to run from Butte, Mont., to Anaconda, Mont., and west through Warm Springs Creek and Fleet Creek cañons to Rock Creek, and thence up the West Fork of Rock Creek to Shalkaho Creek and the Bitter Root Valley, 150 miles. The route is through a mountainous country; maximum grade 2%, and maximum curve 10°. The road is being built in the interest of the Anaconda Mining Co. to develop its lumber and mining traffic. James Lesee is President.

Denver & El Paso Short Line.—Surveys will soon begin for this railway from Denver, Colo., to El Paso, N. Mex., under the direction of Chief Engineer H. G. Ropes. About $10,000 have been raised to make the surveys. The officers of the company are: President, A. McClelland, El Paso, N. Mex.; Secretary, R. Whitmore, Las Vegas, N. Mex.; Treasurer, Albert Lawrence, Las Vegas, N. Mex.

Spokane Southern.—A press dispatch from Spokane, Wash., says:

Some time ago there was organized in this city a railway company known as the Spokane Southern. Its organizers were very mysterious as to the plans projected. It is now understood that the road will run from Portland, Ore., over the cascades along the north bank of the Columbia River until it reaches the mouth of Snake River, and continue along the north bank of Snake River to Almonta, thence north to Spokane, passing through the Palouse Valley. The Spokane Southern articles of incorporation provide for the building of a road from Spokane to Snake River, which will make a loop for the Great Northern from Spokane via Seattle, Portland and Almonta back to Spokane. W. B. Loss, a prominent contractor now surveying a line from the Klickitat River cascades, says the present outlay is made by an English syndicate intimately associated with J. J. Hill.

American Mining Co.—A press dispatch says:

The American Mining Co (limited), of Montana, has just closed a contract with Thomas W. Bates, of Payette, Idaho, to build a standard gage railway from a point on the Oregon Short Line to the Blue Jacket Mine, in the Seven Devils district, in Washington Co., Idaho. Under the terms of the contract construction work is to com-

mence on or before May 1, 1892. Fifty miles are to be completed on or before January, 1893, and the remainder is to be built by January, 1894.

Tulare & Soda Springs.—The Board of Supervisors of Tulare Co., Cal., has granted a charter to a San Francisco syndicate for the purpose of constructing a railway from Tulare to Soda Springs, Cal. The preliminary surveys have been made.

FOREIGN.

Syria.—A concession has been granted for constructing a railway from Haifa to Damascus, Syria.

San Salvador.—A dispatch from San Salvador via Galveston, says:

The minister of public works has approved the surveys and profile of plans submitted by Triguerous Orellana & Son for a line of railway between San Salvador and Santa Tekla, and the work of construction will be begun at once. Simultaneously a line will be built between La Libertad and Santa Tekla, making another route between the capital and the coast.

Honduras.—A press dispatch says:

Arrangements have been made by the Chicago & Central American R. R. Co. with a London syndicate for the money to build the proposed 350 miles of road in Honduras. John H. Screyner, of London, the agent of the syndicate, has negotiated for the securities with London capitalists. The road is to be built from Ivona, a point on the northern coast of Honduras, about 60 miles east of Truxillo, a distance of 250 miles, to the capital. A Chicago company is back of the enterprise, and has been given a concession of 2,000,000 acres of land by the government. Robert L. Martin is President of the company; D. A. Courter, Vice-President.

Australia.—A bill will shortly be submitted to the Victoria Parliament providing for a loan of $50,000,000. The money is to be used in the construction of railways and other industrial enterprises.

Mexico.—The Mexican Government has granted a concession for a standard gage railway, about 350 miles long, from the City of Mexico to a town on the Pacific Coast on Palizada Bay, and the letting of the contract will take place during the present month.

Apam & Cazones.—Gov. Marquez, of Puebla, and Maunel Arrioja have applied to the Mexican Government for a concession to build a railway from Apam to Cazones, Mex.

Piedras Negras & Monterey.—Lionel Samuels, who is making a preliminary inspection of the country between Piedras Negras and Monterey, Mex., for this road, is reported as saying that a very favorable route can be accrued. He expects to make his report soon and that construction will begin in a short time.

CITY TRANSIT.

Electric Railways.—*Malden, Mass.*—The East Middlesex Street Ry. Co. has applied for power to adopt electricity on its 17 miles of road to Revere Beach, Woburn, etc.

Newark, N. J.—The Elieson accumulator system will be tried on the South Orange Ave. line.

Baltimore, Md.—The North Avenue Electric Ry. Co. will be assisted by the Jarvis-Conklin Mortgage & Trust Co., Kansas City, Mo., in the construction of its road to Roland Park. The work will cost about $1,000,000.

Natural Bridge, Va.—The Glasgow Investment Co. proposes to build an electric road from the railway station to the hotel.

Staunton, Va.—The Staunton Development Co. may build an electric road.

Asheville, N. C.—The Asheville & Biltmore Ry. Co. has been organized to build an electric line to Biltmore, 2½ miles. President, W. E. Breese.

Greensboro, N. C.—Proposals for building and equipping an electric road 3½ miles long will be received by R. M. Douglas.

Rome, Ga.—Mr. J. S. Lawrence, of Washington, D. C., is president of the company which has purchased the street railway lines, and will adopt an electric system.

Columbus, Ind.—A syndicate headed by Hon. George W. Cooper is formulating a plan for building an electric line to Nashville, the county seat of Brown Co., a distance of 20 miles. It is thought the line can be built and equipped for $40,000.

St. Louis, Mo.—The work of converting the old St. Louis Cable & Western road to an electric road has been done by the St. Louis & Suburban Electric Ry. Co. Mr. Winthrop Bartlett was the engineer. The materials were furnished by the following firms: Power-house, 150 × 130 ft., brick, with truss roof; also $40,000 car shed, 475 × 132 ft., for 300 cars; Givens & Steinhoff. Lumber, St. Louis Refrigerator & Wooden Gutter Co. Structural iron work for power-house, Scherpe & Koller Architectural Iron Co. Roofing, J. M. Sellers. Boiler plant; Rohan Bros. This includes 6 boilers, 70 ins. diam., 20 ft. long, with 26 flues 6 ins. diam.; 30% of the power is in reserve. A double set of boiler feed pumps, and the Rohan feed water heater and purifier are used. The belting was supplied by the Shultz Belting Co., and includes 2 belts 72 ins. wide and 150 ft. long, and ten 16-in. belts 70 ft. long. The cars are being built by the St. Louis Car Co. The 20,000 ties and 1,500 cedar poles were supplied by the C. F. Collins Lumber Co. Girder rails, 8 miles of 70-lb. steel rails on Wharton rolled steel chairs, 27 ins. apart, with six bolt joints; Wharton, Jr., & Co., of Philadelphia. Frogs, curves, switches and crossings; Elliott Frog & Switch Co., of East Louis, Ill. About 100 miles of trolley and feed wire supplied by Ezra H. Finley.

Companies.—Columbus & Westerville Ry. Co., of Columbus, O., to build an electric road; M. H. Neil, E. H. Reesoner, George W. Williams; $100,000. Central Electric Ry. Co., of Paterson, N. J.; $30,000. Lancaster & Strasburg St. Ry. Co., of Lancaster, Pa.; to build an electric road; President, John A. Coyle; $125,000. Latrobe & Derry Electric Street Ry. Co., of Latrobe, Pa.; President, John W. Hughes; $40,000.

Cable Railways.—*Baltimore, Md.*—The City Passenger Ry. Co. has accepted an offer from Alexander Brown & Sons to take the entire issue of $2,000,000 bonds to cover the cost of cabling three of the company's lines.

Elevated Railway.—*Philadelphia, Pa.*—The Northeastern Elevated Ry. Co. has given the contract for ironwork to the Phœnix Iron Co., of Phœnixville, Pa., at about $2,500,000, or $500,000 per mile. The minimum headway will be 14 ft. The structure will be of lattice construction, designed for 2 locomotives of 50,000 lbs. each, followed by a train of passenger cars weighing 40,000 lbs. each.

Horse Railways.—Tamaqua & Lansford Street Ry. Co., of Tamaqua, Pa., F. P. Spiese; $50,000. San Bernardino Street Ry. Co., of San Bernardino, Cal.; $10,000. Quitman Street Ry. Co., of Quitman, Ga.; John S. Harris, George W. Everett and P. Denmark; $5,000.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Saxton's River, Vt.*—There is talk of replacing the bridge at this place with an iron structure.

Evansville, Ind.—The Evansville Bridge & Terminal Co., has been organized to build a bridge across the Ohio River at this point and to construct railway terminals at Evansville. The bridge will consist of one 550-ft. span, and two 430-ft. spans.

Saginaw, Mich.—The Central Bridge Co., of Saginaw, Mich., has been organized, with $25,000 capital stock, to build a bridge across the Saginaw River.

Sangamon, Co., Ill.—The Board of Supervisors of Sangamon Co., Ill., will receive bids for the masonry and iron work, separately or together, for a bridge over the Sangammon River, near Springfield, Ill. The bridge will have one 160-ft. span and one 120-ft. span, 16-ft. between trusses, and capable of carrying a load of 80 lbs. per sq. ft. There will be two tubular iron piers 28 ft. × 36 in, and 20 ft. × 30 in. respectively. The masonry will consist of two abutments, each 20 ft. long and 3 ft. wide at the top.

St. Charles, Mo.—N. L. Jenkins, County Engineer of St. Charles Co., is preparing plans for a highway bridge over the Missouri River at St. Charles. The plan will be on the basis of a $175,000 structure with tubular iron abutments. The proposed plan will provide for pedestrians, vehicles and street cars.

HIGHWAYS.

New Jersey.—Work on the new Hudson Co. road is expected to be commenced next spring, under the Board of Freeholders. Mr. E. B. Harrison is the engineer. It will begin at Ave. A, Bergen Point, and run to the Bergen Co. line, a distance of 14 miles, connecting with the Bergen Co. system of macadamized roads. When completed there will be a continuous macadamized road from Bergen Point to Nyack, 45 miles. It will be 80 to 100 ft. wide, with a 60-ft. carriage way, of which 20 ft. will be macadamized.

Colorado.—A road in Hinsdale Co., from Carson to San Juan, is proposed by Carson people. It will be 18 miles long, with only 3 miles of heavy work.

Washington.—A survey has been made for a road commencing at Sluice-box Creek on the Spokane Co. line and running via Diamond Lake to Newport, on the Pend d'Oreille River and Idaho line. The Great Northern Ry. crosses at Little Falls, 1½ miles above and thence down the river to Newport. From there to the Spokane Co. line, the new county road and the railway are nearly on the same line, and the latter is building the greater portion of work on the new county road so as to have the use of it in forwarding the construction supplies.

WATER-WORKS.

NEW ENGLAND.

Cape Elizabeth, Me.—It is reported that a special election will be held to vote on building works.

Lancaster, N. H.—The Lancaster Water Co. has organized with William Clough, President, and W. H. McCarten, Clerk and Treasurer. It is expected that construction will be started at once. There will be 60 hydrants.

Haverhill, Mass.—The Aqueduct Co.'s works will be transferred to the city Nov. 14. H. W. Rogers has been elected Superintendent.

Danbury, Conn.—A proposed increase to the supply is being investigated.

MIDDLE.

Bath-on-the Hudson, N. Y.—It is reported that the village trustees are trying to obtain a better supply of water. The present works are owned by a company.

Fort Edward, N. Y.—The people will vote on contracting with the Spring Brook Water Co., Sandy Hill, for fire protection at a cost not exceeding $1,800.

East Syracuse, N. Y.—A survey has been made for a supply from White Lake. Address the Water Commissioners.

Glens Falls, N. Y.—A new storage reservoir is talked of.

Mechanicsville, N. Y.—The sum of $90,000 has been voted for the proposed new works.

Merrick, N. Y.—Works are being built for a general supply, which will be pumped from driven wells to an elevated tank. Address H. H. Cammon.

New Paltz, N. Y.—An annual tax of $875 has been voted for hydrant rental.

Port Henry, N. Y.—A vote of 80 to 29 has been cast in favor of works.

Homestead, Pa.—It is reported that Council has sold $50,000 of water bonds, and that the new works will be completed by spring.

Stroudsburg, Pa.—It is reported that the company has increased its capital stock from $15,000 to $30,000, and will build a new dam or drive a well.

Towson, Md.—Works are still projected, at present, it is reported, by New York capitalists.

SOUTHERN.

Fairmont, W. Va.—A contract for works to be completed within 60 days has been let for $19,950.

Elberton, Ga.—An election will soon be held to vote on introducing water and electric lights.

Mobile, Ala.—The mayor advocates city ownership of water-works and sewerage plants.

Plaquemine, La.—A 5-mill tax for 10 years has been voted for works.

Burksville, Ky.—Works are projected. Address W. Godfrey Hunter.

Parkland, Ky.—Works are talked of.

NORTH CENTRAL.

Glendale, O.—Works are projected. A supply pumped from driven wells to a stand-pipe is talked of. Estimated cost, $30,000. H. B. McClure is Mayor.

Mansfield, O.—The Ohio Water Co. has been incorporated; capital stock, $10,000. Works were built in '72 by the city.

Benton Harbor, Mich.—The people have voted to issue $50,000 in bonds for the purchase of the company's works.

Menominee, Mich.—About 900 tons of pipe varying from 8 to 16 ins. in diameter will be added to the distribution system. A 3,000,000-gall. engine has been erected and the intake will be extended 1,000 ft. into Green Bay. Dunham & Paine, New York City, are Engineers.

St. Joseph, Mich.—The city wishes bids until Nov. 21 for building complete works. See invitation for proposals in advertising columns.

Carbonville, Ill.—The *Republican* advocates a water supply from Thompson's Lake.

Rock Island, Ill.—A 5,000,000-gall. Gaskill pump has been contracted for.

Tuscola, Ill.—Bonds to the amount of $12,000 have been voted for works.

Warren, Ill.—It is reported that surveys for works are to be made.

Hillsborough, Wis.—Bonds for works have been voted.

NORTHWESTERN.

Duluth, Minn.—The Council has decided to submit to the people, on Nov. 16, a proposition to buy the property of the Duluth Gas & Water Co. for $1,950,000. Mr. W. C. Sargent, it is reported, holds an option at this figure and offers it to the city.

Parsons, Kan.—It is reported that the company thinks of building a large storage reservoir in Neosho Co.

Fargo, N. Dak.—Bonds to the amount of $40,000 are to be issued to fund the floating debt and pay for extensions.

Butte, Mont.—The Silver Bow Water Co. and Silver Bow Hydraulic Mining Co. will each transfer their property to the Butte City Water-Works Co. this month. Some improvements will be made this fall and extensive ones are projected for next year.

SOUTHWESTERN.

Aurora, Mo.—Contracts are being let. J. W. Nier, Kansas City, is engineer.

Cape Girardeau, Mo.—Bids for a franchise will be received until Dec. 7. Address the mayor.

Joplin, Mo.—Two 1,500,000-gall. Deane pumps have been tested. A new station has been built. Engineer for improvements, J. W. Nier, Kansas City.

Kansas City, Mo.—City Engineer Butts claims that some of the items in the experts' estimate for city works are too high, and puts the cost of works for present needs at $1,778,618, instead of $2,002,435, the experts' figures.

Hope, Ark.—Plans are being made for the proposed city works, estimated to cost $22,000. T. M. Battle is Recorder.

Alexander, Tex.—Works are projected.

Gatesville, Tex.—S. S. Mayo & Co., and not S. S. Mazo & Co., as stated three weeks ago, have the contract for works here.

Elgin, Tex.—It is probable that the contract for works will be awarded to M. P. Kelley, Dallas.

Quanah, Tex.—It is reported that a company proposes to put in water-works, an ice factory and electric lights.

PACIFIC.

Chehalis, Wash.—A 30-years franchise has been granted to Frank Donohue, L. Lawrence and Charles Maynard. The works must be completed by September, 1892, and the city may buy at the end of 10 years. Supply, Newaukum River, through a flume.

Montesano, Wash.—Surveys for the new city works have been made.

Roslyn, Wash.—D. B. Ogden, of Ogden & Bosworth, Tacoma, has reported upon an increase to the supply, to be pumped from the Cle-Elum River. Pumping to the present reservoir seems to be favored.

Seattle, Wash.—A new 20-in. cast-iron main from the Lake Washington station to the reservoir, at an estimated cost of $35,000, and a 36-in. suction pipe have been recommended.

Tacoma, Wash.—The Tacoma Water-Works Committee are investigating the Mashell River, 32 miles southeast of the city, as a possible water supply. A preliminary report has been rendered by the committee's engineer, Fred. G. Plummer.

La Grande, Ore.—Nov. 2 the people were to vote on issuing $30,000 of bonds to be used with $20,000 in hand for city works. The present works are owned by a company.

Monmouth, Ore.—The Monmouth Water Co. has been incorporated by P. L. Campbell, J. C. Powell and others; capital stock, $6,000.

Pendleton, Ore.—An offer to furnish a new or additional supply to the city has been made by the Blue Mountain Irrigation & Improvement Co., and referred to a council committee.

Healdsburg, Cal.—The *Enterprise* advocates bonding the town for $30,000, and buying the present private works.

Riverside, Cal.—It is reported that Hall's Addition Co. will lay mains to distribute filtered water for domestic use, and that the present mains will be used for irrigating purposes.

San Diego, Cal.—About three miles of new mains are proposed, the extension being known as the Golden Hill main.

Truckee, Cal.—There is talk of laying mains and obtaining fire protection by connecting with a mining tunnel for a supply.

CANADA.

Amherst, N. S.—Bids for $60,000 of city water bonds were to be received until Nov. 5. The present works are owned by a company. N. Curry is Chairman and R. C. Fuller Secretary of the Water Commissioners.

ARTESIAN WELLS.

Eastman, Ga.—A well is projected.

Chamberlain, S. Dak.—A dispatch from this point states that bids are being received for sinking a well on the Rosebud Agency, and that if successful other wells may be sunk on this and the Pine Ridge Agency.

Pierre, S. Dak.—It is reported that the recently incorporated Land and Improvement Co. will sink several wells.

Albany, Tex.—An experimental well will, probably be sunk.

Giddings, Tex.—The sum of $4,000, it is reported, has been raised for a well.

Hillsboro, Tex.—It is reported that a well will be sunk on the property of Mrs. N. A. Haley.

Lufkin, Tex.—Money for a well is being raised by subscription. Address J. F. Davis or B. F. Bonner.

Mexia, Tex.—Efforts are being made to secure the sinking of a well.

Rosalia, Wash.—A well is down 45 ft.

IRRIGATION.

Aberdeen, S. Dak.—Booth & Hazard, Minneapolis, have contracted for the construction of a 10,000,000-gall. reservoir and ditches on their farm in Fountain township. Contractor, James Ringrose, Aberdeen.

Encinitas, Cal.—An irrigation district is being formed. Address E. A. Tuttle, Oceanside, or Isaac Martin, of this place.

San Bernardino County Cal.—It is reported that the Riverside Trust Co. will soon begin to cement 14 miles of open canal at a cost of $4,000 per mile.

San Diego, Cal.—The formation of an irrigation district to be known as the Jamacha, is under way. Address A. H. Peterson, Spring Valley. The projected district joins San Diego on the east, and contains some 220,000 acres.

Santa Maria, Cal.—Arrangements to irrigate 5,000 acres at an estimated cost of $50,000, are reported as under way.

Tulare, Cal.—The irrigation of about 60,000 acres with water from a bayou is proposed.

Hawthorne, Nev.—Nov. 2 a convention was to be held here to discuss an irrigation scheme in Esmeralda Co. estimated to cost $500,000.

New Companies.—Pierre Land & Irrigation Co., Pierre, S. Dak.; $100,000; directors, B. A. Cummins, H. E. Cutting and others. Central Wyoming Canal Co., Cheyenne, Wyo.; $2,500,000; to tap North Platte River in Natrona Co., and build main canal 150 miles long, 6 ft. deep, 100 ft. wide at top. Williams Reservoir Co., Fort Collins, Col.; $1,000.

SEWERAGE AND MUNICIPAL.

Sewers.—***Massachusetts.***—Wakefield. The report of the Sewerage Committee will be considered and acted upon at the next town meeting.—Natick. Sewage disposal by land irrigation is proposed.—Brookline. It is proposed to extend the trunk sewer by a 15-in. pipe at a cost of $13,000.

Rhode Island.—Providence. It is said that the precipitation works are not to be built at once, the sewage being discharged into tidewater.

New York.—Melrose. Plans for the sewerage of Melrose, Westchester Co., have been prepared, and the work will be let in 5 contracts.—Oneida. Mr. W. F. Randall, the engineer, is taking levels for the completion of the plans for the proposed sewer system which are to be submitted to the State Board of Health. If the plans are approved a public vote will be taken.—Medina. The contract for 11,000 ft. of sewers has been awarded to Barlow & Martin, of Seneca Falls, at about $12,000.

New Jersey.—Weehawken. An ordinance has been passed for a 48 and 42-in. sewer of brick and iron pipe on pile foundation on Park Ave. and 18th St.

Virginia.—Roanoke. Proposals have been received for the construction of the sewers, but will not be opened until the question of the intereepting sewer is settled. There is some opposition to the construction of this sewer.

North Carolina.—Durham. The Lewis-Mercer Construction Co., of New York, has made a proposition to build a system of pipe sewers.

Alabama.—Mobile. The Mayor has proposed that the city issue bonds and build a system of sewers.

Ohio.—Salem. The State Board of Health has recommended the construction of a sewerage system——Columbus. A sewage farm is proposed, and a committee will visit the works at Pullman, Ill., and Norfolk, Va.

Michigan.—Ishpeming. Mr. Williams, the engineer, estimates the cost of the proposed system of sewers at $166,000.—— Negaunee. It has been voted by 112 to 10 to issue bonds for $20,000 for a trunk sewer.——Harvey. The cost of the sewers is estimated at $41,000.

Minnesota.—St. Paul. The Board of Public Works has reported that it will cost $50,000 to build a sewer to carry the storm water of Trout Brook and Phalen Creek within the limit of 5th St. and the river.

Iowa.—Waverly. A system of sewers is to be built.—Oskaloosa. About 1¼ mile of 24-in. sewer is being built at a cost of $10,000.

Colorado.—Denver. Mr. Meryweather, the engineer, has submitted to the Board of Public Works plans for additional storm sewers. Catch basins will be built at street intersections.

Idaho.—Boise City. The new sewerage system will include 8 miles of sewers and cost $100,000.

Montana.—Missoula. The contract for sewers has been awarded to Riddell & Watts at $47,700. There will be 57,060 lin. ft. of pipe sewer, averaging 14 ft. deep.

Oregon.—Portland. East Portland is agitating for a sewerage system, plans for which have been prepared by Mr. Rudolph Hering.

Utah.—Salt Lake City. The contract for a 24-in. sewer has been awarded to Hobson & Wilkerson, at $20,027.

Washington.—Olympia. A complete system of sewerage has been designed by Mr. J. S. Camp, City Engineer of Puyallup. The plans provide for a tidal reservoir, from which the sewage will be discharged with the ebb tide. The reservoir will be 100 ft. square, with walls of 8 ft. puddle between double rows of piling. It will be flushed by a siphon, and flush tanks will be placed at the heads of the sewers.——Tacoma. There is opposition to the proposal to discharge the sewage into the bay at 15th St.

California.—San Francisco. It is said that the grades of South San Francisco must be altered to allow of the construction of the sewerage system.—Redlands. An ordinance has been passed authorizing the construction of storm water ditches, and the matter will be submitted to public vote.—Visalia. The cost of the new sewerage system is estimated by Mr. Wm. Ham Hall at $71,000.

Streets.—***Massachusetts.***—Williamstown. Cole Ave. is being macadamized.

Rhode Island.—Providence. The New England Paving Co., of Boston, Mass., will pave Union St. with asphalt concrete.

Connecticut.—New Haven. The subject of the material to be adopted for street paving is under discussion by the Street Committee.

Oregon.—Salem. An ordinance has been passed providing for the paving of streets on 25 blocks.

Washington.—Tacoma. Mr. Morrison, the city engineer, has recommended bituminous rock paving for avenues and residence streets, and stone blocks or corrugated brick for uphill streets, the city to pay for street intersections. He estimates the cost as follows: Macadam, 11 cts. per sq. ft.; wooden blocks, 28 to 30 cts.; brick, 25 to 29 cts.; bitumen, 25 to 30 cts.; stone, 33 to 55 cts. For residence lots, with the roadway narrowed down to 40 ft., the cost for each 25-ft. lot would be approximately: Brick on 4 ins. of concrete, $125 to $140. Bitumen on 4 ins. of concrete, $125.

Bonds.—Nashville, Tenn.; $75,000 for sewerage, $150,000 for water works. Negaunee, Mich.; $20,000 for sewers. Allegheny, Pa.; $950,000 for improvements proposed. Stevens Co., Wash.; $35,000. Snohomish Co., Wash.; $250,000 for roads and bridges, to be voted on Nov 17. Chillicothe, Mo.; $30,000 for paving sold to V. B. Buck of Kansas City. Roseburg, Ore.; $25,000 for sewerage and city hall.

Drainage.—***Michigan.*** A ditch 4 miles long and 3 to 4 ft. wide, in Bay Co., will be built by H. A. Crane. It will be paid for out of the state swamp land fund by the Board of Control, consisting of the Governor and Secretary of State.

Gas.—***Sioux Falls, So. Dak.***—The Sioux Falls Gas Light Co. has been awarded a 2 years' contract for street lighting at $25 per lamp per annum for 74 lights.

ELECTRICAL.

Electric Light.—***Norwood, Mass.***—A committee on electric lighting has been appointed, including Frank Doane, Geo. B. Talbot and W. C. Fisher.

Stillwater, N. Y.—A contract for lighting the village for 5 years has been awarded to W. Pemble at $500 per annum.

Wheeling, W. Va.—The Edison Electric Light, Heat & Power Co. has applied for permission to put in its plant.

Greensboro, N. C.—Proposals for arc or incandescent electric lighting for the city will be received by the Mayor until Feb. 1.

De Land, Fla.—The electric light company will replace its arc plant with an incandescent plant.

Knightstown, Ind.—A local company has been organized and will furnish 100 incandescent street lights.

Mattoon, Ill.—Proposals for arc lighting will be received by the city clerk Nov. 17.

Milwaukee, Wis.—A special committee has been appointed to investigate the electric lighting question, with a view to the purchase of the company's plant by the city.

Fort Dodge, Ia.—Last spring the citizens by vote instructed the city council to take measures to purchase an electric light plant, to be owned and operated by the city. The council spent the summer figuring with electric appliance companies, and trying to make a deal in that direction that would prove to the city's interest. It finally decided that the city could not at this time purchase and operate an electric light plant as economically as it could contract for street lighting with the Thomson-Houston Co., now operating a plant here. The council has accordingly made a five years' contract with the company.

Little Rock, Ark.—An electric lighting franchise has been granted to H. G. Allis, H. P. Bradford and J. M. Taylor.

Companies.—Walton Electric Light Co., of Walton N. Y.; John Babcock, C. B. Bassett; $20,000. South Florida Electric Co., of Bartow, Fla.; President, F. J. Maywald; Secretary, Frank Clark. Edison Electric Light & Power Co., of Newark, N. J.; T. A. Edison, of Orange; H. Young, L. D. Ward, Moses Bigelow, of Newark; $1,000,000; the company will lay underground wires. Edison Light, Heat & Power Co., of Wheeling, W. Va.; August Rolf, John M. Birch, F. J. Hearne; $500,000. Mifflinburg Electric Light Co., of Mifflinburg, Pa.; Treasurer, Aaron Klose; $1,000. Montrose Electric Light & Power Co., of Montrose, Pa.; O. A. Gilbert; $12,000.

PROPOSALS OPEN.

Water-Works.—***St. Joseph, Mich.***—Complete system: 2 non-condensing duplex pumping engines of 1,500,000 galls. daily capacity, about 7 miles of 4 to 12 in. pipe, with specials, valves, boxes and hydrants; 2 public water closets, and 7 drinking fountains. Specifications now ready. C. A. Keeler, City Clerk. Nov. 24.

Electric Lighting.—***Greensboro, N. C.***—Not less than 50 arc lights of 1,500 c. p., or incandescent lights of equal capacity. J. W. Forbis, Mayor. Feb. 1, 1892.

Electric Railway.—***Greensboro, N. C.***—Construction and equipment of road 3½ miles long. R. M. Douglas.

Roads.—***Brookline, Mass.***—Macadam and telford macadam paving. A. H. French, Town Engineer. Nov. 12

Drainage.—Construction of the Hay Swamp drains. S. J. Latta, Clerk of Hay Township, Zurich, Ont. Nov. 21.

Jail.—***San Bernardino, Cal.***—Architect, C. H. Jones. The Clerk of the Board of County Supervisors. Dec. 9.

Steel.—***Mare Island, Cal.***—About 228, 260 lbs. of steel material for the *Monadnock*. Edwin Stewart, Paymaster General, U. S. N., Navy Department, Washington, D. C. Nov. 24.

Revetment.—***Charleston, S. C.***—Wooden revetment at Mt. Pleasant. Capt. F. V. Abbott, U. S. Engineer Office.

CONTRACTING.

Levee.—***New Orleans, La.***—The Orleans Levee Board has awarded the contract for the Carrollton levee to the Thomas O'Malley Improvement Co., at 19¼ cts. per cu. yd.

Brick.—***Minneapolis, Minn.***—The Sewer Committee has awarded a contract for 4,500,000 sewer brick to Barker & Griner, at $8.40 per 1,000.

Paving.—***Birmingham, Conn.***—The lowest bid received by the Board of Wardens for vitrified brick paving on Elizabeth St. was from Blakeslee & Son, of New Haven, at $2.65 per sq. yd.

Sewer Material.—***Baltimore, Md.***—The following proposals have been received for materials for the Wolfe

St. sewer: Stone: John Harris, $2.15 per cu. yd.; Bergeman & Peddicord, $2.10; J. H. Atkinson, $2.25; John Curley, $1.97; Maryland Granite Co., $1.75. Brick: W. H. Perot, $7.98 per 1,000; Kline Bros., $8.25 and $9.25; Daniel Donnelly & Son, $7.29. Cement: C. C. McColgan & Co., Ulster brand per bbl., $1.25. Crescent, $1.15, Crescent in bags, $1.00, Hanover, $2.75; S. M. Hamilton & Co., Cumberland, in barrels, $1.35, in bags, $1.18; Portland, $3 Hemmor, $2.90, Hanover, $2.75.

Pipe Laying.—*Fargo, No. Dak.*—The contract for laying about 3,900 ft. of 4-in. pipe has been awarded to H. O'Neil at 98 cts. per ft.

Street Work.—*Houston, Tex.*—The following proposals for paving were received by the City Council Oct. 26. The contract was awarded to R. C. Stovell, of Fort Worth, Tex., and will amount to about $340,000. The paving will consist of one course of brick on gravel foundation. The brick will be burned at Garrison, Tex., but the brick company has not yet its plant for manufacturing in large quantities, and work will therefore not be commenced for some time. For asphalt paving the only bid was from the Barber Asphalt Paving Co., for furnishing and laying street asphalt pavement complete, guaranteed for 5 years:

	Class A.	Class B.
With no car track, per sq. yd	$2.30	32.50
With one car track, "	3.00	2.80
With two car tracks, "	3 10	2.70

	Barber Asphalt P. Co., New York.	Chris. Kiel, San Antonio.	E. Byrne, Dallas.	R. C. Storvall, Fort Worth.	John Bavaset, Dallas.	J. C. Baldwin, Houston.
Taking up and resetting old curb walls, per 1,000 brick	$16.24	$20.00	$16.50	$12.00	$15.75	.....
Furnishing and setting 4 × 20 in. stone curbing, per lin. ft	.89	.82½	.80	.87½	.80	.....
Furnishing and setting 5 × 20 in. stone curbing, per lin. ft	.98	.90	.90	.92½	.95	.....
Furnishing and laying brick curbing, per 1,000 brick	18.24	16.50	14.75	18.25	15.75	$19.50
Furnishing and laying hard-burned building brick gutters, per lin. ft	.29	.23	*14.75	.....	*16.75	.....
Furnishing and laying vitrified brick paving brick gutters, per lin. ft	.44	.....	.....	.62½	.....	.....
Furnishing and laying concrete gutters per lin. ft	.54	.....	.....	.59	1.90	.....
Furnishing and laying bois d'arc wood block gutters, per lin. ft	.54	.....	.....	.40	.....	.....
Furnishing and laying brick gutter retaining walls, per 1,000 brick, with hard burned brick	18.24	16.50	13.75	18.00	.....	.....
Furnishing and laying brick gutter retaining walls, per 1,000 brick, with vitrified brick	38.24	.....	.....	22.25	.....	.....
Furnishing and laying cypress retaining gutter walls, per 1,000 ft. B. M	35.00	32.50	22.00	50.00	35.00	.....
Furnishing and constructing brick culverts, per 1,000 brick	18.24	18.50	14.75	18.50	16.75	.....
Furnishing and laying vitrified sewer pipe drains, per lin. ft., 8 in. pipe	.72	.....	.....	.45	.20	.....
Furnishing and laying vitrified sewer pipe drains, per lin. ft., 10 in. pipe	.92	.....	.....	.65	.27	.....
Furnishing and laying vitrified sewer pipe drains, per lin. ft., 12-in. pipe	1.22	.....	.52	.85	.33	.....
Furnishing and constructing wooden box drains, long leaf heart pine, per 1,000 B. M	31.00	32.50	18.00	50.00	27.00	.....
Furnishing and constructing wooden box drains, red heart cypress, per 1,000 B. M	35.00	35.00	22.50	60.00	40.00	.....
Excavation for earth roadbed, per cu. ft	.45	.42½	.42	.59	.37	.39
Furnishing and laying complete bois d'arc block paving, with gravel sub-foundation, per sq. yd	.....	.....	2 75	2.22½	2.15	.....
Furnishing and laying complete bois d'arc block pavement, with sand sub-foundation, per sq. yd	.....	.....	2.65	2.10	2.15	.....
Furnishing and laying complete vitrified brick pavement, with gravel sub-foundation, per sq. yd	.....	2.10	2.75	2.10	.....	.....
Furnishing and laying complete vitrified brick pavement, with intermediate course of hard-burned building or vitrified brick, on gravel sub-foundation, per sq. yd	.....	2.50	3.00	2.45	.....	.....
Furnishing and laying complete vitrified brick pavement, with intermediate course of hard-burned building brick, on gravel sub-foundation, per sq. yd	.....	.....	.....	2.45	.....	.....
Furnishing and laying stone block pavement complete, per sq. yd	.....	.....	.....	4.25	.....	.....
Furnishing and laying telford macadam pavement complete, per sq. yd	.....	.....	.....	2.60	.....	.....
Furnishing and laying gravel pavement complete, per sq. yd	.....	1.16½	2.72	1.90	1.58	.....
Furnishing and laying complete vitrified brick paving, with intermediate course of brick, upon sand foundation, per sq. yd	.....	2.20	.....	2.29½	.....	2.30
Excavation for curb walls and gutters, per cu. yd	.45	.45	.42	.50	.45	.....
Excavation for sidewalks, per cu. yd	.....	.....	.42	.45	.37	.....
Furnishing and laying complete brick sidewalks, per sq. ft	.....	.....	†14.75	.....	.....	.....
Furnishing and laying complete concrete sidewalks, per sq. ft	.....	.....	.25	.....	.....	.....

* Per 1,000 brick. † Probably per 1,000 brick.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., are building an electric locomotive. The Baldwin Locomotive Works of Philadelphia, Pa., have orders for 10 compound engines for the Mexican National, and have delivered 2 to the Houston & Texas Central. The Rhode Island Locomotive Works, of Providence, R. I., are building 6 ten-wheel engines for the Chicago, Milwaukee & St. Paul. The Manhattan Elevated Railway will add 20 engines to its equipment. The New York, New Haven & Hartford has ordered 2 Forney tank engines. H. K. Porter & Co., of Pittsburg, Pa., have built an 11-ton engine for the Brooklyn navy yard. The Roanoke Machine Works, of Roanoke, Va., are building 2 consolidation engines for the Norfolk & Western.

Cars.—The Roanoke Machine Works, of Roanoke, Va., are building 75 box cars, 75 flat cars and 50 coal cars for the Norfolk & Western. The Chattanooga Car & Foundry Co., of Chattanooga, Tenn., is building a number of oil cars and sugar cane cars. The Osgood Bradley Car Works, of Worcester, Mass., and the Wason Manufacturing Co., of Springfield, Mass., have orders for 30 cars each for the Old Colony. The Pullman Palace Car Co., of Chicago, Ill., is building 61 passenger and baggage cars and 9,550 box and gondola cars for the Philadelphia & Reading. The Laconia Car Works, of Laconia, N. H., are building passenger cars for the Lake Shore & Michigan Southern, and stock cars for the Burton Stock Car Co. The Billmeyer & Small Co., of York, Pa., is building passenger cars for the Lake Shore & Michigan Southern. The Barney & Smith Manufacturing Co., of Dayton, O., is building 40 passenger cars for the Chicago, Milwaukee, & St. Paul. The Laclede Car Co., of St. Louis, Mo., is building 350 cars for the Third Ave. cable road, New York. The Pullman Palace Car Co., of Chicago, Ill., is building double truck electric cars for Portland, Ore. The Cincinnati, New Orleans & Texas Pacific is having 300 fruit cars built at Gadsden, Ala.

Car Heating.—The Safety Car Heating & Lighting Co. has sent out the following announcement: "The decision of the Board of Examiners of the Patent Office on Oct. 28, besides allowing it other patents granted the two claims covering broadly the steam heating of railway cars in connection with the Baker heater and its circulating pipes in the application of Henry R. Towne. This application has been involved in a long interference and is the property of this company. No other companies have any right to apply steam heat to railway cars which is to operate in combination with the Baker heater and its circulating pipes without license from the Safety Car Heating & Lighting Co."

Car Heating.—The Consolidated Car Heating Co. write us as follows:

"The success of the appliances of the Consolidated Car-Heating Co has been so great that several manufacturers of more or less reputation have not hesitated to pirate our inventions. The Consolidated Co. desires to warn railway companies of these infringements and thus to acquit itself of the obligation to give such notice. A flagrant violation of the Sewall coupler patents at the present time is especially noticed, where all the essential features are appropriated or closely imitated while the unsuccessful attempt is made to evade the patents. The imitation is complicated and defective. Another conspicuous instance is the placing of steam drums upon the cross-over pipes, which violates the well-protected invention of the Consolidated Co.

This company will prosecute all such infringers of its patents and all those who use such infringements, while assuring railway companies of its indisposition to trouble them in such matters any more than is absolutely necessary for proper self-protection."

The company also informs us that the Patent Office decided on Oct. 28 four important interferences, covering practically the basic principles of car heating by disk, coil or other drums; and that the result of these decisions is to limit the use of the steam drum or jacket of any form in connection with a hot water circulating system in a car to the Consolidated, the Safety and the Gold companies. The patents which will issue are granted, one to Henry R. Towne and three to James F. McElroy. This does not affect in any way the commingler in which steam is noiselessly injected into the water of circulation in a car.

Cattle Guards.—The Bush Surface Cattle Guard Co. informs us that it has won a patent suit in which it was the defendant, and the National Surface Guard Co., the plaintiff, and in which 6 patents of the latter company, including the one relating to the feature of uneven or alternating heights, were declared invalid. The company says further:

The National Surface Guard Co. has been completely defeated in its efforts to retain a monopoly of the business of manufacturing guards, and this outcome is no less a victory for railways than for ourselves.

We are not advised as to the exact scope of the decision, but if, as seems to be implied, the foundation patents on iron surface cattle guards are declared invalid, the decision is one of much importance to the railway interests. The Bush Co. has recently been incorporated, and has enlarged its capital stock. It claims to be now using 75 lbs. more material in each guard than any other manufactured.

The Thomson Meter Co., of New York, states that on Nov. 2, 1887, it had manufactured 680 meters; Nov. 2, 1888, 2,680; Nov. 2, 1889, 4 880; Nov. 2, 1890, 10,000, and Nov. 2, 1891, 20,000. The weight of brass used from Nov. 2, 1890, to Nov. 2, 1891, amounted to 186,000 lbs., and the number of meters sold was 10,000. This event was celebrated at the company's factory in Brooklyn on Nov. 2 by a little celebration given to the men by the company, which consisted of stamping the meter 20,000 by a hammer presented by the men to the officers of the company. The celebration was followed by a lunch given to the men.

Brakes.—The New York Air Brake Co. has the contract for equipping 700 cars for the Burton Stock Car Co.

Steel Pipe Works are to be established at Redlands, Cal., and contracts have been let for the buildings.

Dredge.—A dredge or steam shovel for phosphate digging is wanted by R. Hoffeld, Buffalo, N. Y.

The Engineering Equipment Co. has moved its New York office from the second floor of the Central Building, 143 Liberty St., to the store premises on the ground floor of the same building. The company has offices in New York and Boston. F. L. Perine, General Manager; A. L. Tinker, Secretary and Treasurer; C. J. Field, M. E., Consulting Engineer; Albert C. Hale, Ph. D., Chemist; F. A. Magee, M. E., in charge of the railway department at New York; C. S. Merrill, representing the Underwood belting, and others.

Companies.—Railway Lighting & Heating Co., of Chicago, Ill.; $500,000. Western Improvement Co., of Dubuque, Ia.; $5,000,000. Vanduzen Gas & Gasoline Engine Co., of Cincinnati, O.; $100,000. American Construction Co., of Cincinnati, O.; streets and buildings; $10,000. Acme Railway Switch Co., of East St. Louis, Ill.; J. E. Chambers, George Broach and C. E. Lang; $500,000. Acme Railway Signal & Mfg. Co., of Galesburg, Ill.; J. G. Bohl, W. H. Miller and Emil Lange; $50,000. Standard Smoke Consumer Co., of Portland, Me.; President, Theodore Pinkham; Treasurer, E. B. Hill; $150,000. Burden Water Lift Co., of Jacksonville, Fla.; President, J. R. Tysen; Secretary, P. Sattlekan; to manufacture the Burden water lift and railway water supply tank; $150,000.

Metal Market Prices.—*Rails.*—New York: $30 to $30.50; old rails, $20 to $21 for iron and $16.50 to $17 for steel; girder rails, $40. Pittsburg: $30; old rails, $23.75 to $24 for iron and $17 to $18.50 for steel. Chicago: $31.50 to $33; old rails, $22 for iron and $14 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.7 to 1.9 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.8 to 3 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.1 to 2.2 cts.; iron track bolts, 2.7 cts. with square and 2.8 with hexagon nuts. Chicago: splice bars, 1.85 to 1.87½ cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.75 cts. with hexagon nuts.

Pipe.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½ per cent. on black and galvanized butt-welded; 67½ and 55 per cent. on black and galvanized lap-welded. Casing, 55 per cent.

Foundry Pig Iron.—New York: $14.25 to $17. Pittsburg: $14.50 to $16.25. Chicago: $14.50 to $16.

Lead.—New York: 4.1 to 4.15 cts. Chicago: 4.05 to 4.1 cts. St. Louis: 4 cts.

Structural Material.—New York; beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.9 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.2 to 2.3 cts. for shell, 2.45 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2 to 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.05 to 2.1 cts. for tank, 2.75 cts. for shell, 2.4 to 2.5 cts. for flange, 3.85 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.1 cts.; tees, 2.4 cts.; universal plates, 2 12½ cts.; sheared steel plates, 2.2 to 2.25 cts.; steel plates, 2.1 to 2.12½ cts. for tank, 2.3 to 2.35 cts. for shell, 2.5 to 3.6 cts. for flange.